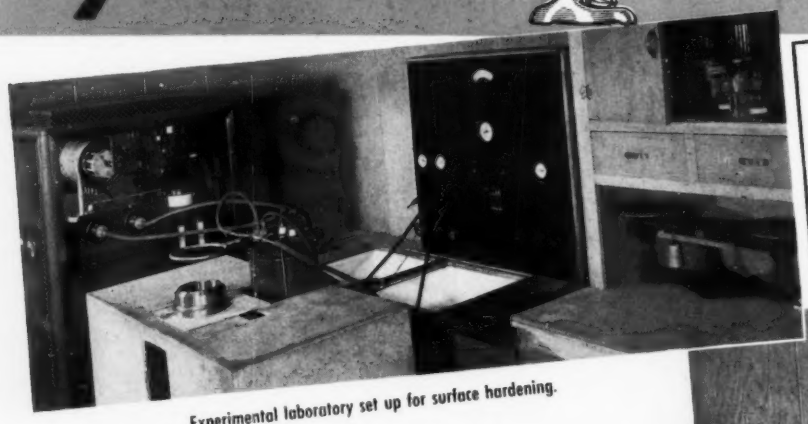
June 1943

TECHNOLOGY REVIEW

Title Reg. in U. S. Pat. Office

Thermonic Laboratories

The Guarantee behind our Production Rate on Thermonic Induction Heating Equipment.



Experimental laboratory set up for surface hardening.

Examining micro-structure of hardened specimens in THERMONIC Laboratory.

For our customer's protection, every production rate, quoted in proposals on THERMONIC equipment, is backed up by thorough laboratory investigation.

IF YOU HAVE A BRAZING PROBLEM

This service includes the cross-sectioning of the joints following brazing to determine the alloy flow, and metallographic analysis to determine the effect of the heating on adjacent sections. Test runs are made on, not one but many samples to ascertain the adaptability of the process to production.

IF YOU HAVE A HARDENING PROBLEM

Hardness values are obtained and the hardenability determined by photomicrographic studies. Temperatures are carefully checked by pyrometric measurements. Again, numerous samples are run, approaching pilot plant technique, to insure uniform results.

IF YOU HAVE AN ANNEALING PROBLEM

Photomicrograph and hardness values are taken as indications of the "before" and "after" physical characteristics, to insure meeting your requirements.

A TYPICAL EXAMPLE OF A HARDENING PROBLEM

Fig. 1

Fig. 2

Fig. 3

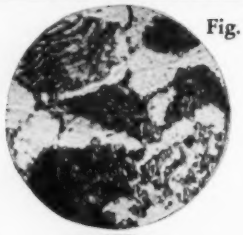
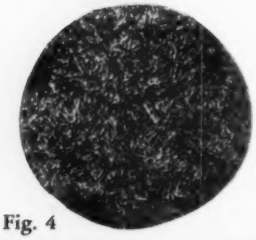


Fig. 4



PROBLEM:

To surface harden a machined ring, S.A.E. 1040 steel, hardness not to penetrate sufficiently to affect the area surrounding the drilled hole, which is subsequently tapped.

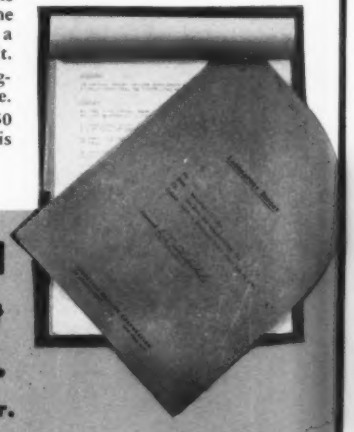
PROCEDURE:

Single turn coil, as illustrated in Fig. 1, heated the outer cylindrical surface of the ring to 1550° F. in 15 seconds, using a Model 1070 THERMONIC Induction Generator. Piece was water quenched, and resultant hardness of Rc 61 was obtained.

Fig. 2 shows an etched cross section. The depth of hardness, transition zone, and original structure are evident. It is clearly seen that the area surrounding the drilled hole remained soft, having only a portion of the transition zone adjacent to it.

Fig. 3 is a photomicrograph taken at 650 magnification of the original pearlitic structure.

Fig. 4 is a photomicrograph taken at 650 magnification on the hardened area; this being a typical martensitic structure.



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Designers • Builders • Of Thermonic Heat Treating Equipment

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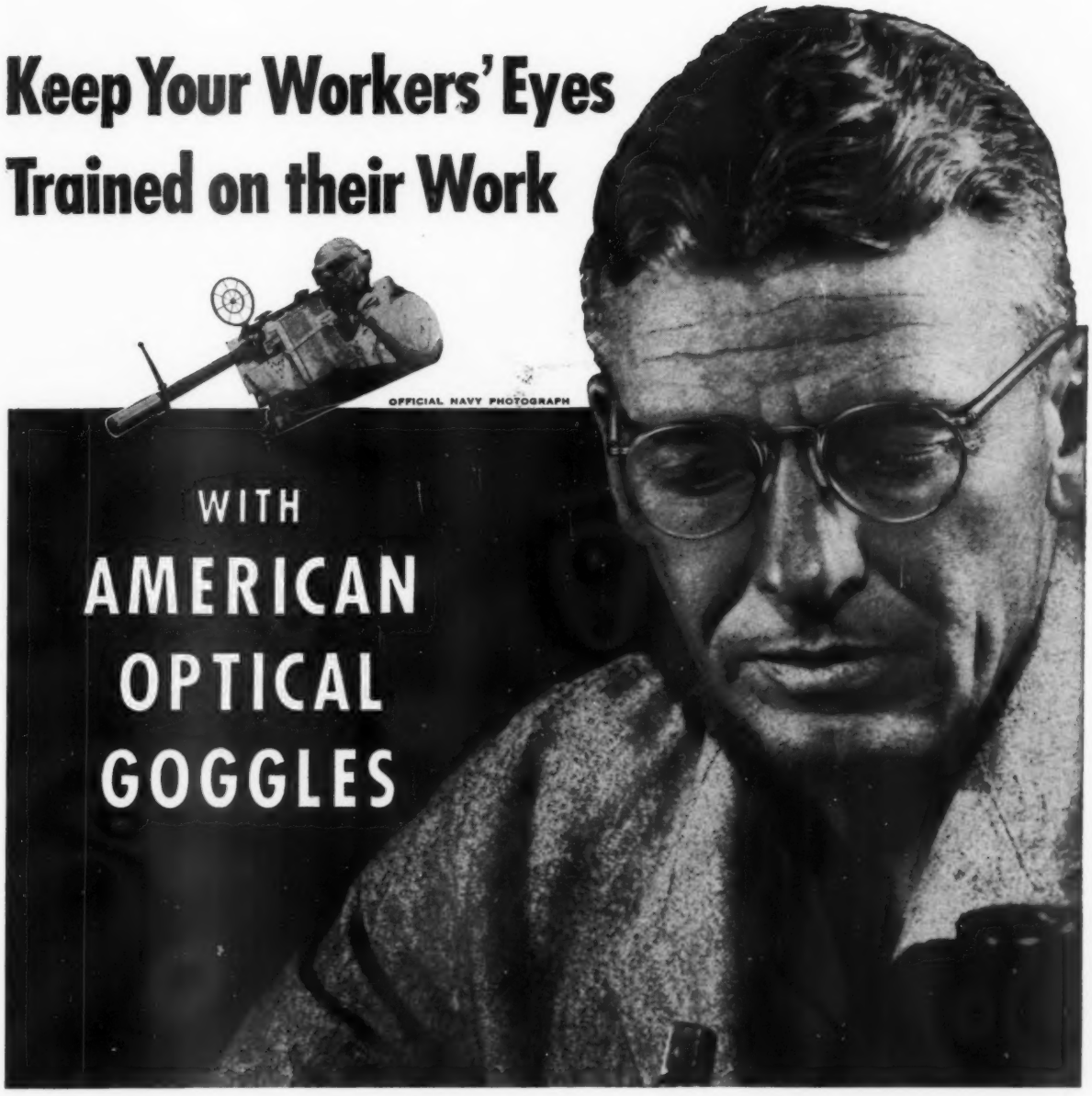
E. S. Goodridge, '33, Pres. **W. A. Gray, '33, Engr.**

Keep Your Workers' Eyes Trained on their Work



WITH
AMERICAN
OPTICAL
GOGGLES

We need more than our workers' hands to win this war . . . we also need their *eyes*. Yet, for lack of proper goggles, industrial eye accidents are *still* occurring at an alarming rate . . . *still* costing our valiant fighting men much equipment that they need to smash the enemy.

Put on an offensive now to stop eye accidents in *your* plant. American Optical Company, pioneer manufacturer of products to aid and preserve vision, offers you the eye protection equipment and complementary services that your plant needs to protect man-power for war-power. AO Goggles are scientifically designed to give maximum possible protection . . . and workers find them comfortable to wear. Have your Safety Director get in touch with the nearest American Optical Branch Office.

American Optical
COMPANY
SOUTHBRIDGE, MASSACHUSETTS

THE TECHNOLOGY REVIEW, June, 1943. Vol. XLV, No. 8. Published monthly from November to July inclusive at 10 Ferry Street, Concord, N. H. Publication date: twenty-seventh of the month preceding date of issue. Annual subscription $3.50; Canadian and Foreign subscription $4.00. Entered as second-class matter at the Post Office at Concord, N. H., under the Act of March 3, 1879.

TYGON LOOKS LIKE *Rubber* FEELS LIKE *Rubber*

.... FOR MANY USES IS BETTER THAN RUBBER!

TYGON might not make a good tire for your car, but that's one of the few places where this versatile, flexible plastic cannot act as a more than satisfactory replacement for rubber.

In hundreds of America's war plants, Tygon, pinch-hitting for rubber, is releasing tons of this critical material for work which rubber alone can do. For many of these applications, the superiority of Tygon has been so pronounced that it is unlikely rubber will ever again be used, even when freely available.

For example, Tygon lining materials have replaced rubber for tanks and other equipment in which corrosive acids are made and handled. Here Tygon's unique properties: its almost "universal" resistance to chemical attack, its remarkable durability, its immunity to the oxidizing elements that tend to destroy rubber, and the tenacity with which it can be bonded to steel without the necessity of vulcanizing or curing, have made most users of chemical equipment forget all about rubber.

Tygon flexible tubing has replaced rubber in laboratories, in hospitals, in industry, in fact wherever a highly flexible tubing is required. Resistant to acids, alkalies and oils, Tygon tubing offers the striking additional advantages of transparency or a broad range of color (both unavailable in rubber), transparency for clearly visible fluid transmission — color for ready identification of fluid lines.

Stoneware engineering research met the need for a replacement for molded rubber mechanical goods by perfecting molding techniques which permitted shaping, in standard rubber molds, of Tygon formulations, possessing not only the desirable physical attributes of rubber but the basic chemical inertness of sheet Tygon.

Possibly in your operations, too, there are places where Tygon may not only conserve precious material for war, but may prove of even greater worth than the material it replaces.

Would you like to learn more about Tygon? Write for Bulletin 1620-B. Address The U. S. Stoneware Company, Akron, Ohio. In Canada: Chamberlain Engineering, Ltd., Montreal.

U. S. STONEWARE
AKRON, OHIO

ENGINEERS • MANUFACTURERS • ERECTORS of CORROSION-RESISTANT EQUIPMENT

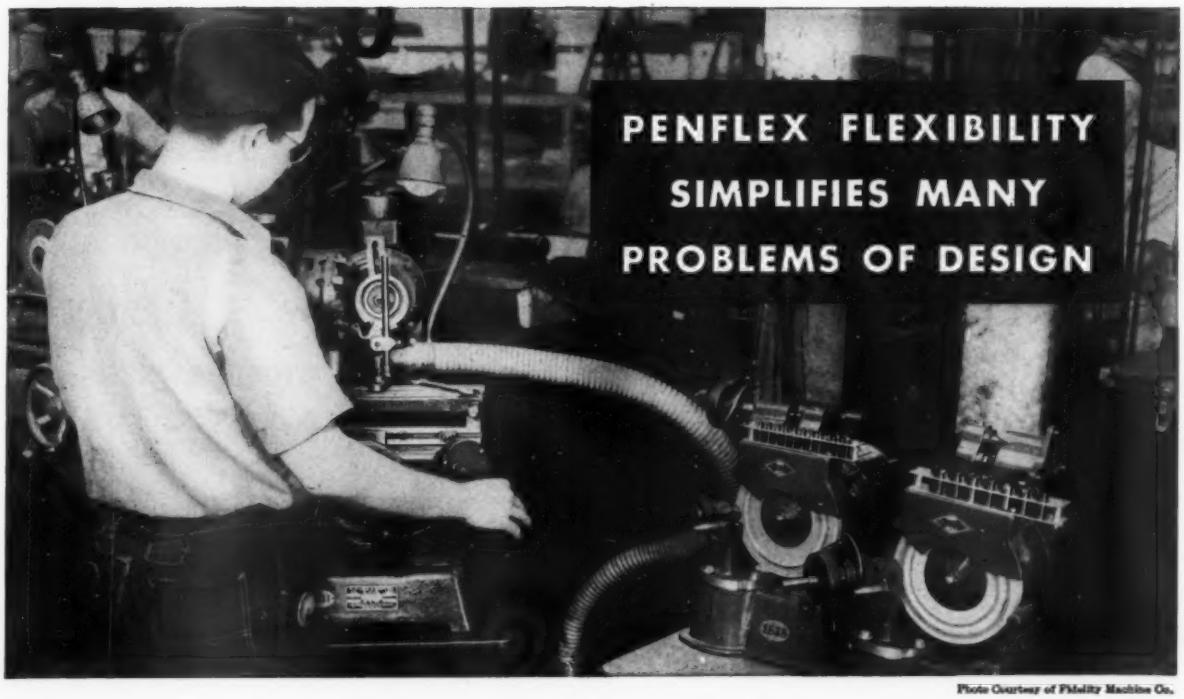


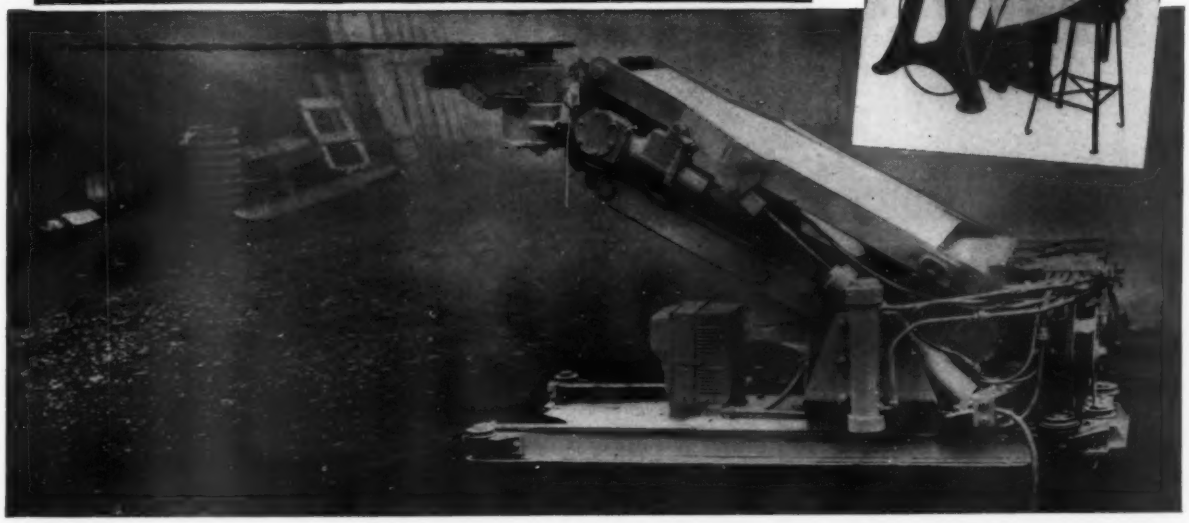
Photo Courtesy of Fidelity Machine Co.

ILLUSTRATED are several applications of PENFLEX Flexible All-Metal Hose and Tubing, showing how PENFLEX simplifies design problems. Light in weight with flexibility to make inaccessible installations easy, PENFLEX All-Metal Hose and Tubing are suitable for mobile units, bilge ventilation, fume exhaust, dust collection, coolant conveying, hydraulic and air controls, vibration isolation, oil can and similar flexible spouting, armor for flexible shafting, conveying of dry granular materials, and many other applications in high or low pressures.

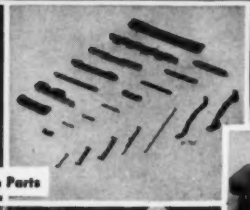
PENFLEX, tight as pipe but flexible, follows any desired path. Material flows through smooth, easy bends without sharp turns to clog.

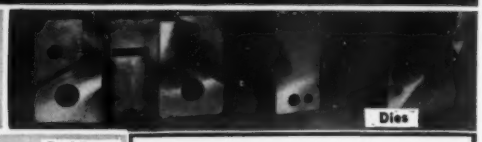
Tell us what type of material you are handling, and the operating pressures. We will send you data sheets promptly.

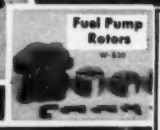
PENNSYLVANIA FLEXIBLE METALLIC TUBING CO.
7211 Powers Lane, Philadelphia, Pa.
ESTABLISHED 1902

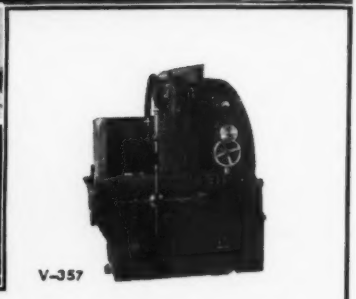


"PUT IT ON THE BLANCHARD"

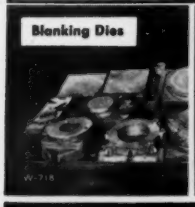


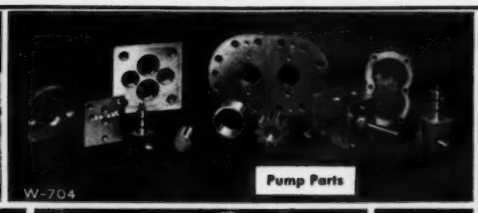


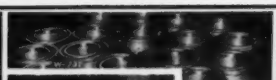


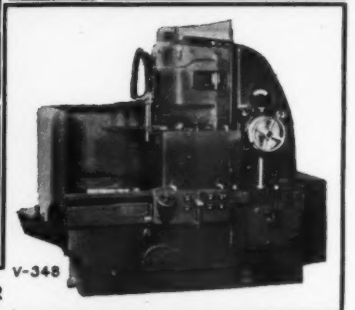


EXAMPLES OF WORK DONE ON THE NO. 11 BLANCHARD SURFACE GRINDER

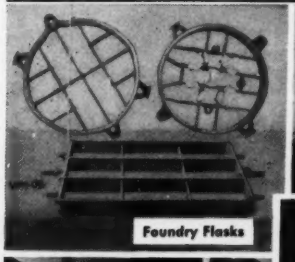


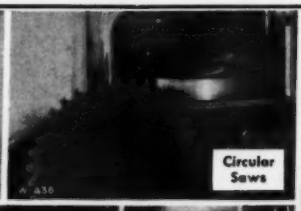


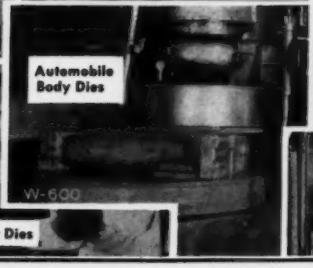


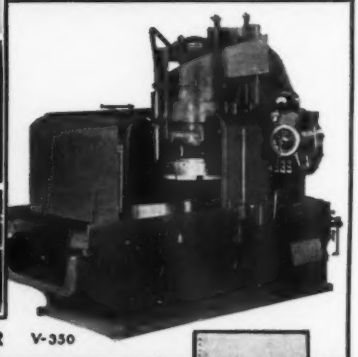


EXAMPLES OF WORK DONE ON THE NO. 18 BLANCHARD SURFACE GRINDER









EXAMPLES OF WORK DONE ON THE NO. 27 BLANCHARD SURFACE GRINDER

The **BLANCHARD** MACHINE COMPANY

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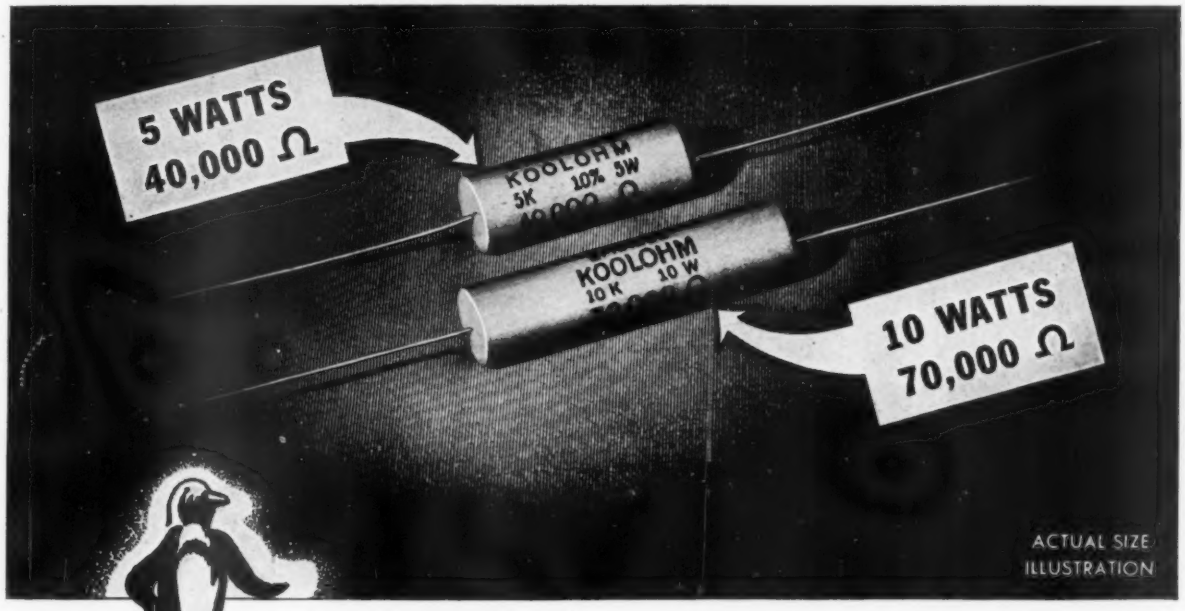
THESE RESISTOR WATTAGE RATINGS MEAN WHAT THEY SAY



...Regardless of the ohmic values

KOOLOHM WIRE IS 2¼ TIMES LARGER

Although Koolohm Resistors themselves are no larger—often smaller—than ordinary resistors, their wire is 2¼ times larger in actual cross-sectional area! This is especially important in the high resistance values where very fine wires so often fail to carry the currents involved in power resistor operation, or to withstand the corrosive effects of operation in high humidities *Play safe* with Koolohms!

If it's a 5-watt Koolohm, use it at its full 5-watt rating—regardless of whether it has a 1 ohm or a 40,000 ohm value! If it's a 10-watt Koolohm you can count on it dissipating a full 10 watts whether the resistance value is 1 ohm or 70,000 ohms!

In brief, there's no need to "play safe" with Koolohms. You don't have to use a larger resistor than you actually require. You can forget your worries as to whether the wire size is big enough to carry the current and the resistor body large enough to withstand the temperature rise involved. *You can use any Koolohm at its full wattage rating—any time, anywhere!*

This freedom of use is made possible because Koolohm design is based upon a time-tested, inorganic insulating material. This is sintered on the wire *before it is wound*—at 1000° C.! The insulation is flexible, and has a dielectric strength of 350 volts per mil at 400° C.!

Samples free to industrial users. Catalog on request to all who are interested in better, more dependable resistors.

SPRAGUE SPECIALTIES CO., Resistor Division, North Adams, Mass.

KOOLOHM

POWER WIRE WOUND RESISTORS AND METER MULTIPLIERS

ALL Nº 000's FEATURES FIT INTO TODAY'S
LIGHT MILLING REQUIREMENTS

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THE TABULAR VIEW

Up in the Air. — Ancient history is expected to be marked by vagueness and controversiality; both qualities, however, apply strongly to much modern history, especially to that of modern technologies, where development has been so swift as often to elude the scholar. No one has done more to free the history of aviation from these difficulties than has S. PAUL JOHNSTON, '21. In this issue (page 419), he dispels the vagueness surrounding the story of William Samuel Henson, pioneer in aeronautical imagining, and in our Mail Returns column (page 410) joins with Fred C. Kelly, biographer of the Wright brothers, in analyzing a controversial issue dating back to the Wrights' early experiments.

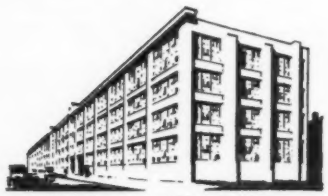
Opportunity. — Discussing another aspect of the problem of postwar economic readjustment which he considered in our issue for April, RALPH E. FREEMAN, Head of the Department of Economics and Social Science at Technology, points out (page 423) the necessity for freedom of action if the forces of technological change are not to impose dangerous strains on the economic structure.

"Gat's" Ancestry. — How the attitude of government toward invention in time of war has changed is clearly stated by GEORGE FORT MILTON (page 425) in his story of Richard Gatling and the famous Gatling gun of Civil War times. Erstwhile editor of the *Chattanooga News*, Mr. Milton is consultant to the National Resources Planning Board and to the Treasury Department. He has written widely on American history of the mid-Nineteenth Century, and as a raconteur of note draws on a limitless store of anecdote and history out of that energetic time.

Social Man. — Imponderable factors in the human equation which are of extreme importance in the personnel relations of industry are evaluated (page 427) by PAUL COHEN, '35, Editorial Associate of The Review and comprehensive analyst of scientific and technological questions.

New Values. — Some of the many ways in which concrete is being utilized to meet new wartime demands are sketched for The Review (page 417) by HARLAND MANCHESTER, special staff writer for the *Reader's Digest* and able reporter on myriad matters.

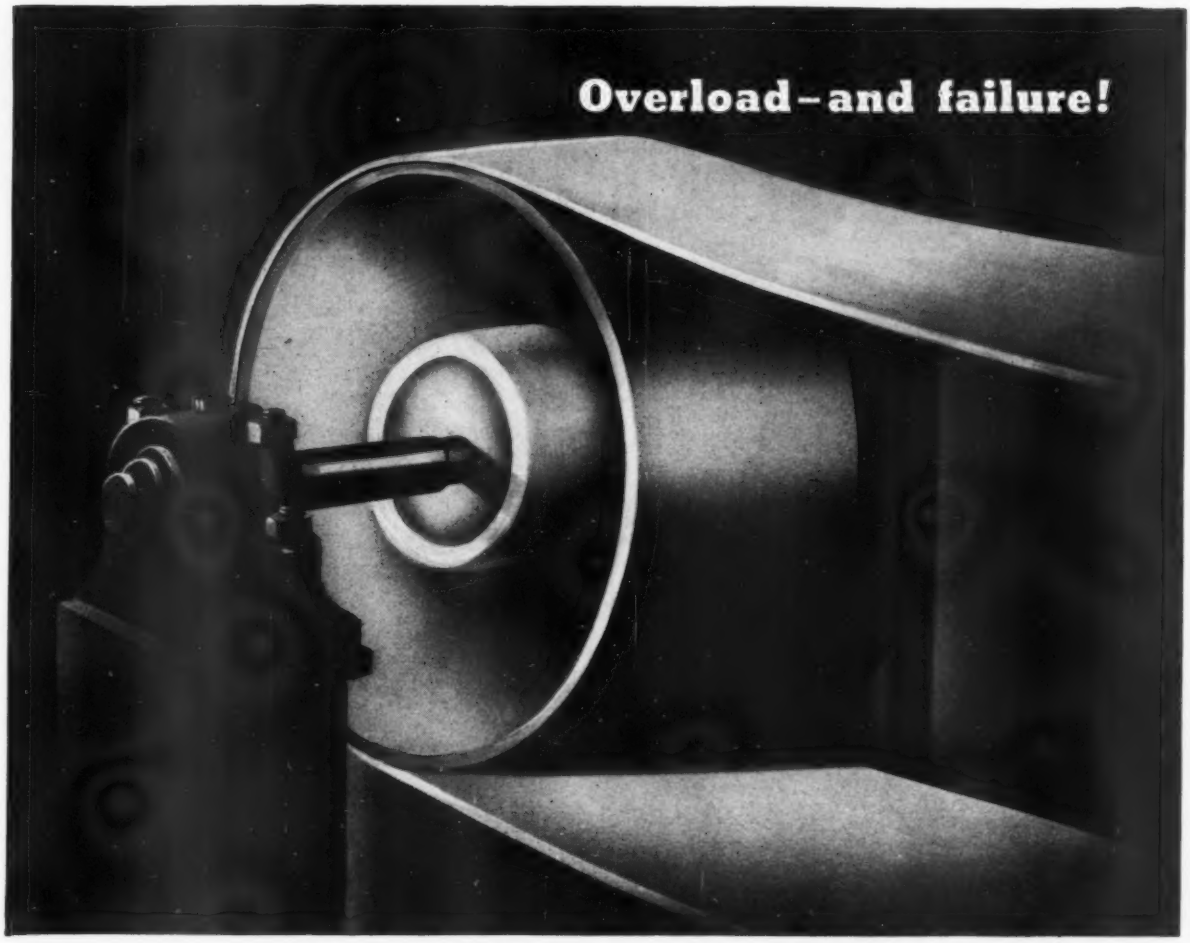
Speed with Economy



Mack International Motor Truck Corp.

Though our basic personnel still remains essentially the same, recent additions to our staff, due to war work, have contributed greatly to our versatility, to the volume of work we are equipped to handle effectively, and to the territory in which we operate.

W. J. BARNEY CORPORATION
101 PARK AVENUE, NEW YORK
INDUSTRIAL CONSTRUCTION
Alfred T. Glassett, '20, Vice President



Information supplied by an Industrial Publication

Recent tests by a well-known rubber company prove that as little as three pounds extra tension on power transmission belting, above recommended tension, will shorten its life as much as 68 percent!

In the tests three grades of the present wartime construction of transmission belting were used. Each belt was run at 15 pounds per inch per ply, a 720 pound total for the tension, the recommended figure, and at 18 pounds per inch per ply, a total of 864 pounds tension, on 4 inch diameter pulleys. Belts were all 6 inches wide, 30 feet long, spliced in 10 foot endless lengths. Tests were all highly accelerated.

Belt No. 1 ran for 95 hours before breakdown under the 19 pound tension, and increased its life to 230 hours before failure when the tension was 15 pounds.

Belt No. 2 ran for 88 hours at the 18 pound tension, and for 263 hours before failure at 15 pounds.

Belt No. 3 ran for 15 hours under 18 pound tension, and the service life before failure jumped to 48 hours under the 15 pound tension.

Close attention to "details" like this will save costly shut-downs and increase productive man-hours. This is just another case of designing to meet requirements — another important conservation measure.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

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Manufactured in accordance with latest Army and Navy Specifications

Special multiple conductor cable made to order — designed for particular applications on instruments and apparatus

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TRADE MARK
HEVI DUTY
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Hevi Duty Electric Co.
Electric Furnaces
MILWAUKEE, WISCONSIN

Hevi Duty Precision Electric Heat Treating Furnaces are built in a large variety of types and sizes — for many heat treating operations — with temperature ranges to 2500° F. (1371° C.). They are standard production equipment in many national industrial plants.

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District Manager
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New York

ELTON E. STAPLES, '26
District Manager
205 W. Wacker Drive
Chicago, Ill.

MAIL RETURNS

The Mysterious Visitor

FROM FRED C. KELLY:

I have recently had my attention called to an article in your issue of March, 1942, in which S. Paul Johnston ['21] quoted from an article of mine in *Harper's Magazine* (August, 1940). Mr. Johnston declared that a statement I made there is untrue. Even though the question in controversy does not seem to me important, I feel as if I should not ignore, even after many months have elapsed, a suggestion that I am an inaccurate reporter, particularly inasmuch as what I wrote is fully supported by incontrovertible facts.

I told in *Harper's* of a mysterious visitor who came in the autumn of 1905 to the field near Dayton where the Wright brothers were making flying experiments; of how this visitor, who did not reveal his identity, turned out to be Charles M. Manly, chief mechanic for Professor Langley of the Smithsonian Institution. Contradicting my story, Mr. Johnston wrote in your magazine, "Whoever the visitor, plenty of evidence is available that it was not Charles Manly." If plenty of evidence is available that the man was not Manly, much more can be presented to show that the man *was* Manly. I shall offer here only part of what is at hand but enough, I believe, to make clear that there can be no question about the identity of the mysterious visitor.

First of all, though, let it be made clear that there was never any indication that Manly had any malign intentions in going to see what the Wrights were doing. There was not a shred of evidence then, and no more today, that Manly had any notion of stealing ideas or knowledge from the Wrights. On the contrary, he made a public statement not long afterward in which he gave them full credit and praise for what they had accomplished. If there can be any criticism against Manly for being a bit mysterious and not revealing his identity, it cannot be against his moral character but only against his sense of discretion. Presumably he had heard exaggerated stories about how secretive the Wrights were and came to the wrong conclusion that he would have been less welcome if they had known who he was. The truth is that the Wrights would have shown every possible courtesy and explained to him more about their machine than he could well have seen at a glance. They knew Professor Langley, with whom they were on friendly terms, to be an honorable man, and would have accepted anyone associated with Langley, in the way Manly had been, as equally honorable. Manly undoubtedly was motivated solely by a desire to satisfy his curiosity — a curiosity naturally more impelling than if he had felt only a casual interest in flying. Since he had worked with Langley during several years of unsuccessful attempts to build a machine capable of flight, his curiosity about the achievements of the Wrights must have been intense.

During the short time of his visit, Manly showed an intimate knowledge of flying machines and great familiarity with aeronautical terms. Charles Taylor, the Wrights' mechanic, who accompanied him into the hangar and workshop, remarked a few minutes later: "That fellow's no writer. At least, he's no ordinary writer. He knows the right name for everything he sees."

In November, a few weeks after the Manly visit, the Wrights received a telephone call from the Secretary of the Dayton Commercial Club (later the Chamber of Commerce), who said he had a telegram from Homer W. Hedge, President of the newly formed Aero Club of America, asking for information about the Wrights' recent flights. In his telegram Hedge said that Charles Manly reported in a speech before the Aero Club (November 14) that the Wrights were able to control their machine in all kinds of weather and that within the last two months they had made more than 50 rounds of their field near Dayton. Later the Wrights received a copy of the New York *Herald* of November 15, containing an article based on Manly's lecture. If Manly had not been a visitor at the Wrights' field, just how did he obtain all the information first revealed in his lecture? No one else had made any statement about what the Wrights had been doing.

A peculiar circumstance was that in a later article dealing more fully with the same subject, the New York *Herald* did not use Manly's name, as it had in the earlier article. In the paragraph telling of the Wrights' recent flights, it attributed the news to "a man in the city who was in the secret of their successes." Why should "a man in the city" not wish to have his name connected (*Continued on page 410*)

When *Black* Means *White!*

OUT OF CARBON . . . blackest substance man knows . . . comes the whitest, brightest light that man has achieved . . . that of the carbon arc lamp. With an intensity of light rivaling that of the sun, the useful carbon arc is necessary in giant searchlights for anti-aircraft defense, battleships, and other vital uses . . . in motion picture projectors . . . in sun lamps that heal and lamps that increase the vitamin D content of milk . . . in accelerated testing equipment that points the way to longer life for fabrics, paints, plastics, and other materials you use.

Without carbon and its wonders, our electrical civilization could not have been born. For without brushes made from carbon, electricity for light and power could not be generated in vast amounts . . . today's automobiles would not run . . . today's airplanes would not leave the ground.

Without carbon, in the form of electrodes and anodes, much of the highest quality steel, many of the chemicals, and other useful substances vital to this nation could not be made. For years, NATIONAL CARBON COMPANY, INC., a Unit of UCC, has studied carbon and graphite . . . their properties and uses . . . and has made useful things from them. Much has been accomplished. Through further research in carbon, more answers for tomorrow's problems are being found.

Research and engineering developments in carbon made by National Carbon Company, Inc., have been tremendously facilitated by the electric-furnace experience and the knowledge of industrial gases and chemicals of other Units of Union Carbide and Carbon Corporation.

BUY UNITED STATES WAR BONDS AND STAMPS

ACTION! CAMERA! Without the high-intensity carbon arc . . . used for photographing motion pictures and projecting them in theaters . . . we would not have the high-quality motion pictures of today.

CARBON, THE VERSATILE. In addition to its electrical uses, electric furnace graphite, a form of carbon, is used for making absorption towers, heat exchangers, and pumps for corrosive liquids; and for making metallurgical molds.

MAN-MADE INFERNO. Modern alloy steels are made in electric furnaces. These furnaces depend upon huge carbon and graphite electrodes for intense heat. They help make more . . . and better . . . steels.

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FOR Victory AND AFTER

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

Our research to maintain and improve the quality of Simplex insulated wires and cables, under restrictions designed to save critical materials, is getting results that mean better insulated conductors for commercial use after the war.

Simplex Wire & Cable Co.
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Our extra quality sash cord, distinguished at a glance by our trade-mark, the colored spots. Especially well known as the most durable material for hanging windows, for which use it has been specified by architects for nearly half a century.

MAIL RETURNS

(*Continued from page 408*)

with the honor of being the first to furnish an account of the Wrights' "successes," unless embarrassed over the manner in which he had obtained the information?

To the Wrights the visitor at the field had seemed nervous, ill at ease, anxious to get away, though he had been seen in the distance for two or three days before. After the man went away, and Orville and Wilbur Wright were wondering who he could have been, Orville remarked: "If I ever see him again, I'm sure I'll know him." Some time later when the two did meet, in New York, Orville was indeed sure. Everything in Manly's appearance and manner of talk corresponded exactly to the man who had visited the field.

Mr. Johnston seems to base his contention (that Manly was never at the Wrights' field) largely on the state of Manly's mustache. He says that the Wrights "recollected clearly that their visitor had no mustache at all, or that it was 'very close cut'"; but that "before, during, and after autumn of 1905 Charles Manly wore a magnificent 'handle-bar' mustache." He adds that "ample photographic evidence is extant on that score." On these points Mr. Johnston, it appears, is simply mistaken. There is no evidence in existence that the Wrights "recollected clearly" what kind of mustache Manly had when he was at the field. In a letter written long afterward regarding Manly's visit, Orville Wright expressed his clear recollection of Manly's appearance when he met him for the first time *as Manly* — that is, when they were introduced to each other in New York. Orville remembered that at the time of their New York meeting Manly's mustache was close cut, not at all a handle-bar type. Notwithstanding what Mr. Johnston says, many pictures of Manly have been published, some taken just before 1905, others afterward, up to almost the time of his death, showing him without any mustache or with only a small one. True, a picture of him was published in the New York *Herald* (late November, 1905) in which he had a handle-bar mustache, but he looked so youthful that the picture had evidently been taken some time previously.

All available evidence points to the mysterious visitor to the Wrights' field as having been Manly. But what of it? I repeat that nothing about his going there or about any use he afterward made of the information obtained reflects on Manly's character.

Peninsula, Ohio

Still Mysterious

FROM S. PAUL JOHNSTON, '21:

I have read with interest Fred Kelly's comments on my article, "Aide in Aerodromics," which appeared in The Review for March, 1942. Although I see no great point in debating *in extenso* a very minor point of history, I am still of the opinion that the mysterious visitor at the Wrights' hangar at Dayton in September, 1905, was not Charles Manly. The original statement was based on a considerable amount of research, and I have discovered nothing since to cause me to alter it.

During the fall of 1940, after the appearance of Mr. Kelly's article in *Harper's* for August, Basil Manly went to some lengths to establish the fact that his brother Charles had not visited Dayton in September, 1905. Orville Wright wrote him a long letter on September 30, 1940, describing the visit in detail. In touching on the matter of the mustache, Wright said: "Our recollection was that the man at the field had none. If he had one, it was small."

Basil Manly was closely associated with his brother then and later, especially during 1907, when they worked together on the Langley *Memoir*. He is certain that Charles wore the luxurious "handle-bar" mustache during 1905 and for many years thereafter. The "handle-bar" shows up clearly in several photographs made both before and after the date of the alleged Dayton visit, which are preserved in the family records. It was the kind that does not sprout overnight.

Those who knew Charles Manly well during his lifetime have been questioned about the Dayton visit. The list includes Basil Manly, Albert Zahm, and C. B. Veal, Manly's later partner. None of them has any reference to such an incident. Yet all these people were his intimates, and with them all he discussed constantly matters pertaining to aeronautical development. (*Concluded on page 458*)

GRINDLINS *raise mischief with surface grinding too!*

The Grindlins are not fooling this operator.

"Quit kiddin'," he says. "There are exceptions to grinding rules. I'd use a wheel as soft as G or H and take extremely light cuts for surface grinding, IF we were grinding a solid piece of hardened steel with a larger area of contact.

"—But this piece is not solid. We have here interrupted contact and, because of that, the grinding wheel must be somewhat harder—say about J or K grade. And I can bear down a little more, taking heavier cuts.

"You Grindlins can cause a lot of trouble for the fellow who doesn't know there are exceptions to general rules."

NORTON COMPANY • Worcester, Massachusetts
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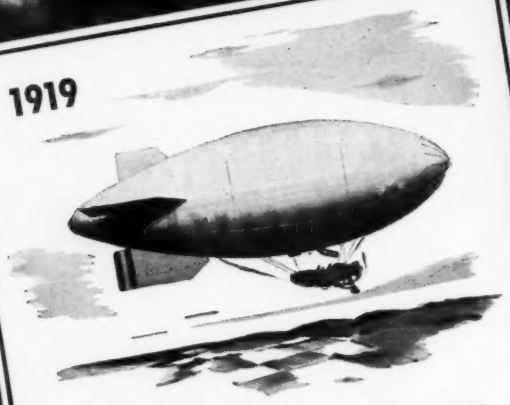
NORTON ABRASIVES

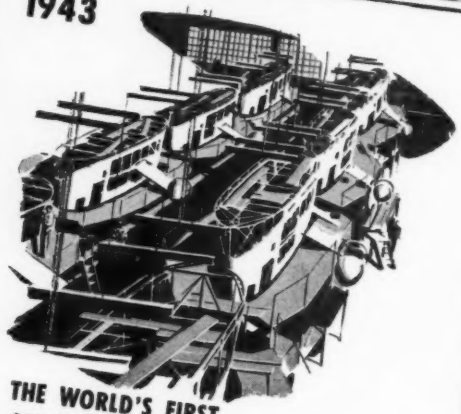
Trail Blazing in the Skies

1919



THE PIONEER COMMERCIAL AIRSHIP in the United States was the "Pony Blimp," built by Goodyear in 1919 to demonstrate the possibilities of small lighter-than-air craft. Based at Los Angeles, it ferried passengers to Catalina, located and mapped deep-sea fishing grounds and was frequently employed in photographic work. This small ship of only 35,000 cubic-foot capacity provided much engineering and aeronautical knowledge that was later incorporated in the famous Goodyear blimp fleet.

1943



THE WORLD'S FIRST AIRSHIP ASSEMBLY LINE is operated today by Goodyear in building large submarine-patrol airships for the U.S. Navy. Here, by continuous mass-production methods, squadrons of sky cruisers are being speeded out in rapidly increasing numbers—the largest, fastest, farthest-ranging non-rigids the U.S. Navy has ever used. This high-speed construction is made possible only by Goodyear's quarter-century experience in airship fabrication—a "know how" that is proving invaluable today in guarding this nation's sea lanes.

HOW GOODYEAR AIRCRAFT CORPORATION SERVES IN AERONAUTICS

1. *By building parts to manufacturers' specifications.* **2.** *By designing parts for all types of planes.* **3.** *By re-engineering parts for mass production.* **4.** *By extending our research facilities to aid the solution of any design or construction problem.* **5.** *By building airships and airplanes for the government.*

GOODYEAR

GOODYEAR AIRCRAFT

Vermont Marble Company

Terrace by terrace, a quarry bottom is cut deeper into the marble of Vermont.

VOLUME 45 NUMBER 8

THE TECHNOLOGY REVIEW

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EDITED

AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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From a photograph by M. F. Gentsch from Black Star

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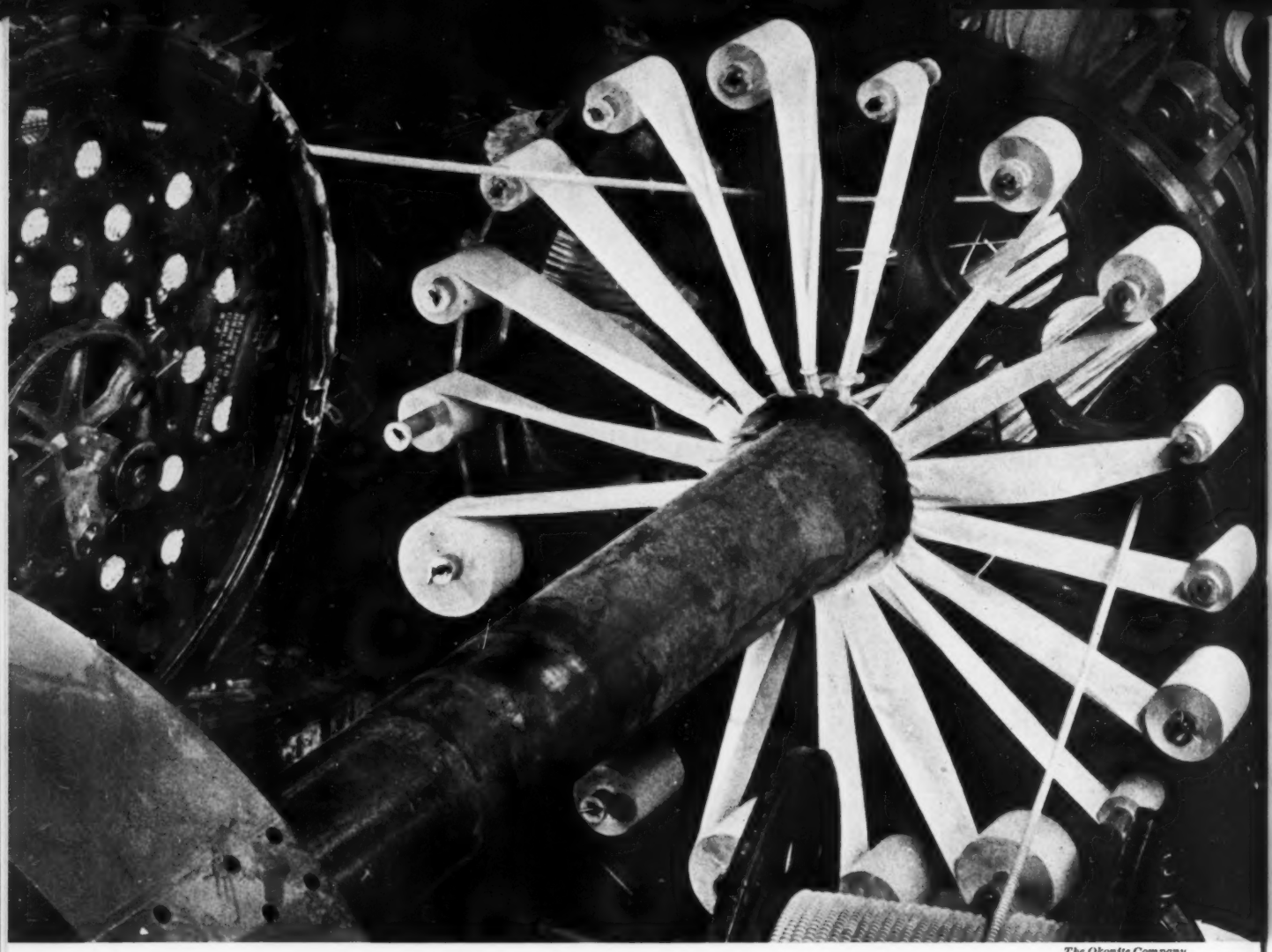


The Okonite Company

A pin wheel of paper as bobbins feed it into the closing die. Here it is crushed to fill spaces between conductors in the longest continuous length of multiconductor paper-insulated cable ever built for high voltage power transmission. Weighing nearly a quarter-million pounds, the 2¼ miles of completed 23,000-volt submarine cable required a special railroad car for transportation.

THE
TECHNOLOGY
REVIEW

Vol. 45, No. 8

June, 1943

The Trend of Affairs

Drilling with Decorum

THE drilling of oil wells is regarded by the uninitiated, with some justice, as a pursuit for roughnecks. Oil derricks are not aesthetically satisfying. They tend to surround themselves with dirt, odors, and soul-shaking noises. It is, therefore, not an unmixed blessing for a city to discover that it is built over an oil field, and derricks on the front lawn — town-lot drilling, as it is called — have on occasion become such an evil that regulation by law has become necessary. Since the 1890's, oil fields in and around Los Angeles have been known and exploited, mostly with shallow wells which in many cases have ceased to be profitable producers and have been abandoned. Oil-bearing strata are suspected to exist below some of the played-out sands, and the city of Los Angeles has zoned a 1,500-acre tract for drilling, in part because of government insistence that for military reasons California increase its crude oil reserves. The operation, however, has been surrounded with many restrictions relating to noise, dust, and odors, and the city council has also made the provision that all the drilling to tap the strata beneath the zoned tract shall be done from a single location only 18.8 acres in area.

The initial test well is being drilled with a unique derrick, whose standard steel skeleton is completely covered with soundproof and fireproof insulation. A large door can be raised to permit the introduction of piping and apparatus. Otherwise, work goes on in an artificially lighted and ventilated interior, the usual scrapes and bangs associated with drilling being muffled into inaudibility within a short distance of the well. The company undertaking the job has even indulged in a little landscaping. More drilling in Los Angeles under more or less the same conditions is reported to be now in prospect. This noiseless oil well, with the promise it offers of enabling oil-well drilling to proceed in urban areas without destroying property values or becoming a nuisance to the citizens, has excited considerable comment in the industry. The aspect of the project which seems most unusual to the layman — that of drilling from one small location possibly scores of wells whose bottoms drain thousands of acres — has, on the contrary, been taken matter-of-factly. During the past decade, the petroleum industry has developed a wide variety of surveying instruments and deflecting tools for wells. By means of these, controlled directional drilling has become a routine practice. With the aid of compasses, gyroscopes, pendulums, automatic photographic recording equipment, and many other devices, all incased in long, slender housings which can slide easily through thousands of feet of tubing, the inclination and direction of the well can be accurately determined, enabling operators to start thousands of feet away and drill close enough to a burning oil well to snuff it out from many feet below the surface, or do the more prosaic but also difficult job of drilling a really straight hole, saving time, mechanical troubles, or the lawsuits which can follow if a well should drift off into someone else's property. One analysis has shown that every time a well is allowed to deviate more than 3.5 degrees from the vertical, an average of six days' drilling time is lost.

Directional drilling has been widely used to side-step the effects of surface obstacles, whether they be natural like lakes, or man-made like wharves, buildings, and other surface improvements. Off Elwood, Calif., wells have been drilled from piers extending 2,000 feet from shore, the wells being only 8 feet 6 inches apart at the top but hundreds of feet apart at the bottom. Had each well required a pier, the field would have been exorbitantly expensive to exploit. In many cases, underwater oil deposits have been drained entirely from adjacent dry land.

Paul J. Woolf

Irrigation engineering in primitive terms: Zuñi women damming the stream that serves their pueblo, in order to divert water to the corn patches that fringe its banks

One for the Book

THAT *The Book; the Story of Printing and Bookmaking* * by Douglas C. McMurtrie, '10, is the seventh revision of a volume which originally appeared in 1927 under the title *The Golden Book* indicates several things: The history of the art which has contributed so greatly of good and ill to the development of our civilization is a very long and involved one; Mr. McMurtrie is an assiduous scholar who is not content to stop short of completeness, and his subject is rich in new discoveries; he is also one of those fortunate beings who enjoy writing about a well-known and well-loved subject and hence can impart that enjoyment to their readers.

For *The Book* is in unusual degree a volume to be enjoyed. Though it is a "discussion of books and their makers . . . written from the viewpoint of the designer and printer," it speaks to anyone who has an appreciation of books as such, or of the values of design, or of the profound satisfactions in history of something other than wars and politics.

On this last count in particular, *The Book* is a storehouse of vitally interesting material that has bearing on a score of techniques in addition to that of printing, which is of course its main focus; a good unit of evidence in support of this is the admirable chapter explaining what conditions existed in Europe in the early Fifteenth Century, to be precipitated into the invention of printing from movable types — a chapter anticipated by Mr. McMurtrie in The Review for November, 1940. Concluding the survey in this volume with the admission that the invention resulted from a synthesis or combination of known elements, Mr. McMurtrie well observes, however, that "the creative power of synthesis is one of the highest and most exceptional of mental faculties."

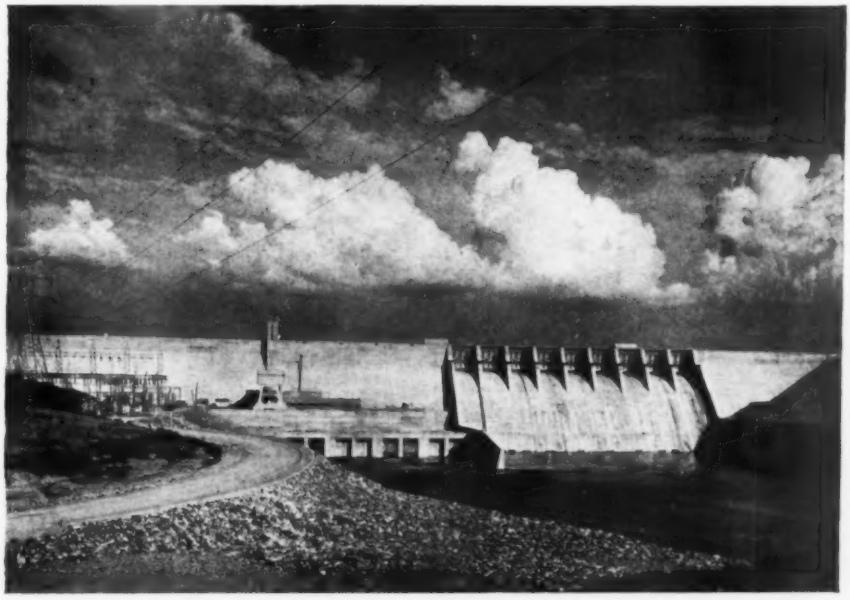
To recount what has been done with and by the result of that synthesis in the centuries since the 1440's is the principal undertaking of *The Book*. Throughout, that story is told with a friendly ease that makes readily assimilable an otherwise almost forbidding array of fact and scholarship. As a consequence, the reader will the more appreciate Mr. McMurtrie's concluding discussion of present-day conventions and practices in typography, and his pungent setting forth, in the final chapter, of ideals for the printer of the future.

* New York: Oxford University Press, 1943. xxx+710 pages. $5.00.

Remuda

UNDER the rulings of the Food and Drug Administration on the manufacture of oxygen, the gas as now compressed and sold is suitable for human consumption, whether in manufacture it was intended for industrial or hospital use. As a result, all the oxygen on a battleship, for example, whether it is there to be used in welding or in hospital applications, can be employed for the emergency treatment of wounded sailors. ¶ A method of chromeplating steel, devised by an engineer of a publishing firm in order to give longer effective life to "doctors" — blades which scrape excess ink from the copper cylinders used in gravure printing — is aiding in the war effort through partly relieving the tool-steel shortage. The knife-edge of a cutting tool which has been subjected to the process can be frequently resharpened with no loss in effectiveness. The life of the tool is reported to be increased many times as a result. A treated drill made 8,000 holes in phenolic sheet without requiring regrinding; 4,000 holes were the limit for an ordinary drill. ¶ The traffic engineer is finding additional important work as a result of the war: The six o'clock shift of the largest war industry plant in Rhode Island now moves away from the factory in 14 minutes instead of 35, thanks to improved routing. In Tacoma, Wash., other traffic experts found ways to save comparable working time through eliminating a single-road bottleneck serving some 40 per cent of the 10,000 workers of a war plant. ¶ Victory gardeners who can can can can if they want to; those who can't can or don't want to can can dehydrate. Such a canny conclusion seems justified by various reports of the development of home dehydration processes, some involving simply the use of wooden trays, covered with cotton netting, in the family oven; others calling for the use of plywood cabinets, with lamps for even heat, a small electric fan for circulation, and removable trays for drying the produce; and still others, as yet at the drafting-board stage, presaging mass-produced dehydrators to be plugged into the domestic lighting circuit. ¶ Among the many reforms

which peace is expected to bring in its train, reform of the calendar is much mooted. Argument is that for any alteration of habit and custom so far reaching as calendar reform would involve, some international document of such scope and substantiality as a peace treaty is the needed vehicle. Plans for new calendars are and have been numerous. One which has been widely noted is the work of Willard E. Edwards, '26, who has been actively interested in the problem for a good many years. Late in April, the house of the 22d session of the legislature of the Territory of Hawaii adopted without opposition a resolution urging Congress to propose the Edwards calendar for adoption by all nations at the future peace conference and to propose to all the United Nations that they name national committees to study the Edwards calendar with a view toward adoption of it at the peace conference. The calendar which Mr. Edwards has drawn up sets New Year's Day as a day apart, leaving 364 days for the remainder of the year. These are evenly divisible by 2, 4, and 7 into equal half years, quarters, and whole weeks. Monday is established as the first day of the week. January begins on Monday and has 30 days; February, on Wednesday, and has 30 days; March, on Friday, and has 31 days. This pattern of "30, 30, 31 — Monday, Wednesday, Friday" is repeated in each quarter. The 366th day which marks leap year is inserted each fourth year between Sunday, June 31, and Monday, July 1, and is regarded as a day apart. ¶ Equal and in some ways superior to printing plates made of war-scarce copper, plastic plates are carrying a steadily increasing share of the printing load. Principal user of plastic plates is the Federal Government; for example, some 20,000 plastic cuts go overseas from the Office of War Information each month. Shipping costs are cut to the bone, since the plastic plates weigh only about an eighth as much as the metal plates which they replace. Another prime advantage from the pressroom point of view is that, if damaged, the plastic plates can be repaired as metal plates cannot. Plastic plates that can be etched as metal is, and therefore can be used in the direct production of original photoengravings, are available to a limited extent. Further development in this field would promise answer to many a printer's prayers. ¶ Of the mineral-fuel reserve of the United States, more than one-sixth is represented by 939 billion tons of lignite, or "brown coal," the American Society of Mechanical Engineers was told recently. Though it contains more water and ash than does ordinary coal, following of proper procedures in handling and burning lignite should make possible more extensive use of it. The principal lignite deposits of the nation are in Texas, Montana, and the Dakotas. ¶ Mirrors and light rays replace targets and ammunition in the precision sighting of semiautomatic rifles by means of recently developed new equipment. The sight setting from a "master" rifle which has been correctly sighted by firing is transferred to rifles subsequently sighted in the new device, which is called an "optical rifle sighting gage." In the sighting of each gun, 13 rounds of ammunition, as well as considerable time, are saved by the new process, which establishes in rifles subjected to it the relationship between line of sight and line of bore determined by the master rifle.



Cherokee Dam and powerhouse constructed by the Tennessee Valley Authority, with Theodore B. Parker, '11, newly appointed Head of the Institute's Department of Civil and Sanitary Engineering, as chief engineer

Concrete to the Rescue

BY HARLAND MANCHESTER

IN this day of shortages, we have at least one abundant raw material left. There is no limitation to the supply of Portland cement. It is made of plentiful ingredients like lime, silica, alumina, and gypsum, and processed in plants all over the United States. It is cheap, it is versatile, and builders and manufacturers are now using it in countless new ways. To mention concrete manhole covers, bathtubs, oil storage tanks, traffic signs, sash weights, and precast stairways is only to suggest the variety of applications which save critical materials. Of lasting significance are new techniques which have brought concrete construction farther in the last two years than it had traveled in the previous decade.

Because of a new method of concrete construction, the latest "biggest factory in the world" is now nearing completion months ahead of time, and the newest plane engines will soon be rolling off its assembly line. When the firm of Albert Kahn got the order for the plant last year, they drew up plans for a building of structural steel, but they found steel hard to get. They next

considered building the vast, one-story structure with an arch-rib roof of reinforced concrete supported by concrete pillars. But conventional concrete construction is slow business on a rush war job. The bottleneck is the building of temporary wooden forms which must remain in place until the cement sets and then must be torn down and reassembled as construction proceeds — a method costly not only in time but in timber and carpenter man-hours.

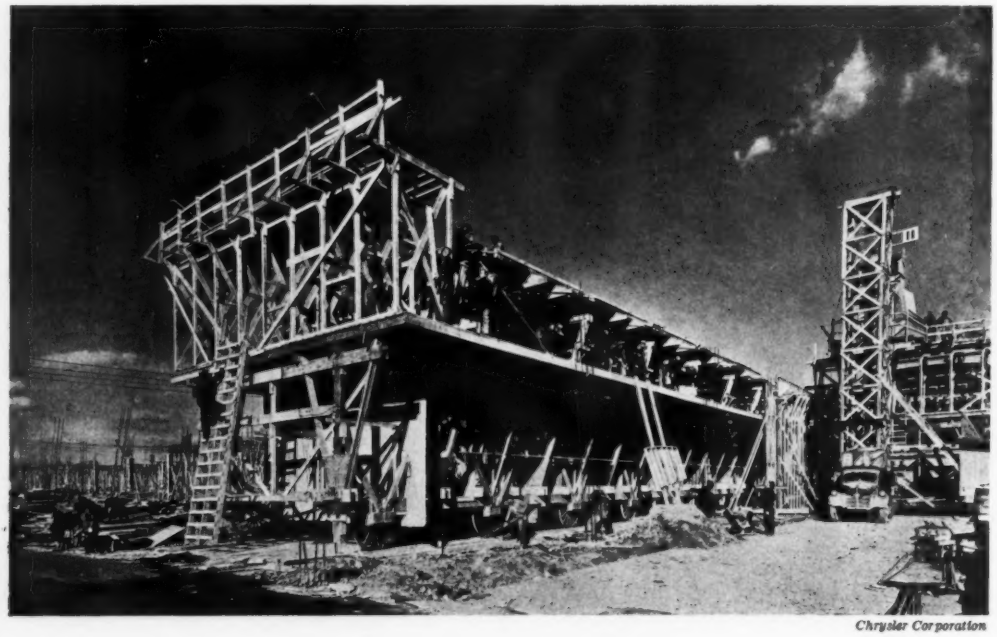
The problem was solved dramatically by erection of huge, tablelike, portable forms that were mounted on artillery wheels. After the concrete was poured on the first section of roof, and the special quick-hardening cement was firm, the tabletop was lowered a few feet by means of special elevators and pulled by truck to the next position. Onlookers stared as the battery of giant tables marched down the length of the tremendous building, leaving behind them the concrete shell of the new factory. Form work which once took four days was now done in one. The plant will be completed in six months' building time, according to the latest estimate, and with the same amount of material and labor it would have taken a year by the old method. Using similar portable forms, a New Jersey war-plant contractor placed five acres of concrete a week instead of the one acre which used to be par, and the same method is being used to rush a plane-engine plant in Kansas City.

Another development — vacuum concrete — which hardens in ten minutes so that workmen can walk on it, contributed to the swift construction of the War Department's great Pentagon Building in Arlington, Va. Vacuum concrete is the invention of Swedish-born Karl Billner of Philadelphia. Six years ago, Mr. Billner astonished skeptics by devising a portable mat with a plywood back and a rubber washer around its edge. A hose from the mat was connected with an exhaust pump. He lowered the mat over a freshly laid section of concrete sidewalk and started the pump. Ten minutes later he removed the mat, and a 200-pound man walked over the fresh pavement without leaving footprints. Billner proved that quick removal of the "free water" not only hastened production but often improved the quality of the concrete. Wartime need for speed has brought the invention into its own, and his batteries of suction mats have quick-cured over a thousand acres of concrete surface in war plants, barracks, bridges, and administration buildings. Since the vacuum-treated floors will support workmen a few minutes after the pouring, wall finishing and other inside jobs can proceed at once.

The mobile concrete plant has been streamlined for new war jobs. When emergency water pipe lines were needed for thousands of new war workers in Norfolk and Newport News, a New Jersey firm moved its plant to the site on 35 freight cars and used derricks to dump the wet mix into upright pipe molds. Germany has mobile plants to repair bombed buildings. Standardized sheet sections of concrete are poured on the spot, hardened quickly by artificial means, and hoisted into place by cranes.

Lightweight concrete, in which burnt clay particles, pumice, furnace clinkers, and other light fillers are used in place of gravel or crushed rock, is attracting wide attention. The 14,000-ton *Concrete Number I*, a tanker launched last fall in California, carries many thousand additional barrels of oil because the use of burnt clay reduces her weight. Foundation costs have been reduced in hundreds of buildings by the use of these light aggregates, while for use in house construction are lightweight slabs which will take nails, may be cut to fit, and provide excellent heat and sound insulation.

In England, houses are being built of slabs made of treated sawdust mixed with cement and other ingredients. The slabs are fire resistant, can be sawed or nailed like wood, and are so light that women can do much of the construction work — a big (*Continued on page 454*)



Chrysler Corporation

Juggernaut concrete forms, some of them more than 120 feet long, speed the construction of a war plant. After a cycle of seven days, during which the forms are rolled into place and set, and the concrete is poured and dried, they can be moved to new positions in eight minutes.

Grandfather of Flight

*William Samuel Henson, Long a Shadowy Figure in Aeronautical History, Emerges in Clearer Outline**

By S. Paul Johnston

ON Friday, the 23d of March, 1888, readers of the Newark, N. J., *Daily Advertiser* noted with satisfaction that "slightly warmer, fair weather" was in prospect. The politically inclined viewed with alarm or chuckled with glee over a report that a bolt of lightning had struck the Senate wing of the nation's Capitol ("balls of fire" had frightened the august occupants, had knocked down a bored cab horse tethered outside). The internationally minded bumbled approvingly over a cable that "Queen Victoria started yesterday for Cherbourg" (the weather being foggy, the Queen traveling as Countess of Balmoral). Sportsters in barroom and barbershop argued loudly a dispatch that the "Men of Washington" had neatly trounced the New York Giants to the tune of 6 to 5 (Crane pitched for New York, O'Day for Washington).

But an historic moment had passed without headlines. Little noted, it was mentioned only in the obituary column of the day:

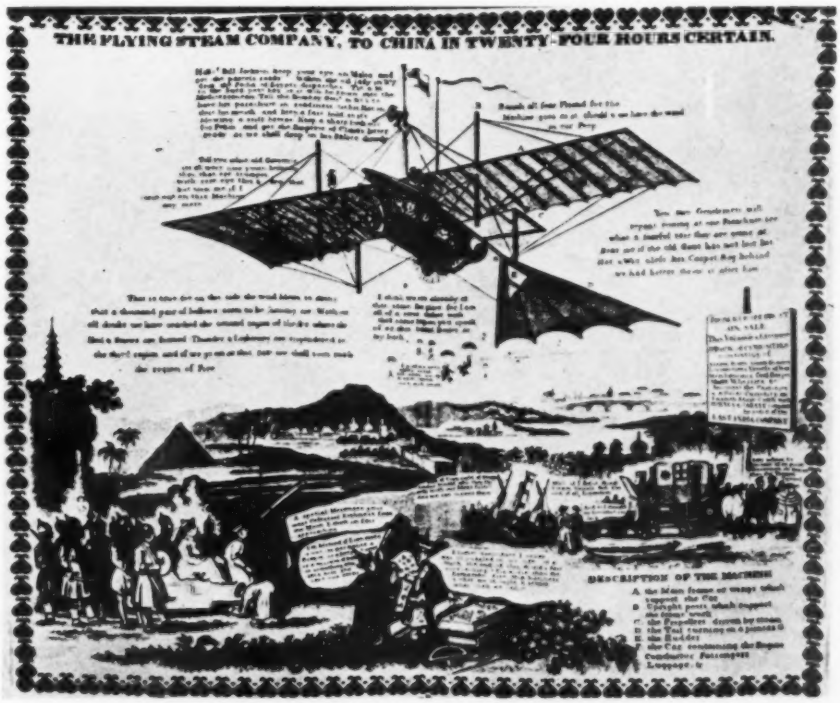
HENSON — On the 22nd inst. William Samuel Henson, in the 76th year of his age. Funeral tomorrow, notice of which will be found in tomorrow's paper.

Again a seemingly unimportant event went unremarked; no funeral notice made the paper the next day. By the 24th of March, the name was almost as completely buried as the man.

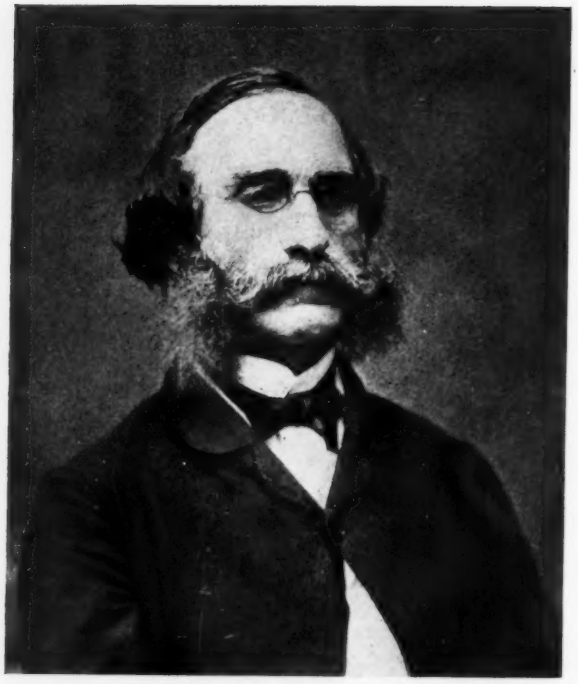
Thus passed in obscurity, many miles and many years removed from the scenes of his short-lived fame, a man who, following in the footsteps of Sir George Cayley, dreamed dreams of heavier-than-air flight and its commercial implications almost a hundred years before science and technology made such things possible.

It was once said of the aeronautically inclined that "a man doesn't have to be crazy to be in aviation — but it helps." Certainly Henson's patenting his "aerial steam carriage" in England in 1842 and the subsequent public promotion of a company to establish an air line from London to the "Plains of Hindustan" caused a deal of eyebrow lifting among the neo-Victorians. Of course, his ideas were quite impractical at the time. He had no knowledge of structural strength requirements. His notion of the power needed for flight was completely unrelated to fact. But full credit must go to Henson

* Recently, many data concerning Henson's life have been uncovered. Clippings, letters, and diaries long buried in cellar and attic have been made available through the courtesy of Henson's granddaughter, Winifred Lipsham, and her father, George W. Lipsham, of Orange, N. J. A grandson, E. T. Henson, also contributed to a new fund of Hensoniana.



This printed linen handkerchief of 1843 reflected the public's opinion of the Aerial Transit Company. Somewhat tongue in cheek, we suspect, it shows how the coming of the air lines would scrap other forms of transport — an idea that still has some currency.



The only known photograph of William Samuel Henson. It was taken in Lima, Peru, probably in 1866. He was then 54 years old.

for an imagination that then conceived a form of aircraft describable in the same terms which apply to a modern monoplane. More than that, he suggested for the apparatus an application which approximated the specification of a modern air line. His patent application was for more than a mere flying machine. It dealt with "Certain Improvements in Locomotive Apparatus and Machinery for conveying Letters, Goods, and Passengers from Place to Place through the Air." Unfortunately, his thinking far outreached the capability of his times to grasp.

As was to have been expected, the scribes and the printers had a field day. Fanciful stories such as the famous Glasgow hoax (in which a certain Professor Geolls of Glasgow described as fact a hair-raising adventure involving the explosion of a Henson *Ariel* while in full flight over the river Clyde), political diatribes, cartoons, and bits of doggerel dotted the British press.

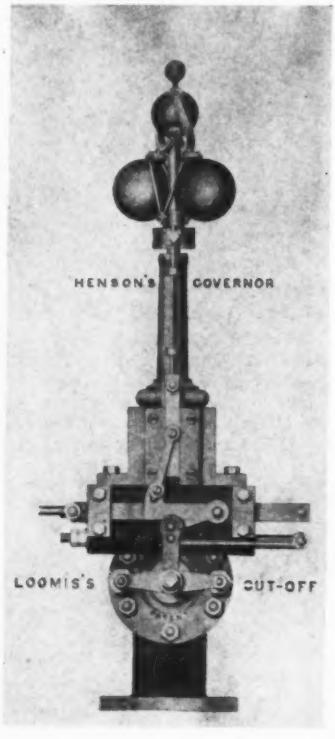
It matters not, I understand, whichever way the wind is
They'll waft you in a day or so, right bang into the Indies!
. . . . . .
Or you may dine in London now, and then, if you're romantic,
Just call a ship and take a trip right over the Atlantic.

French and German magazines picked up the story but, on the whole, treated it more seriously than did the home papers. In America, the *New World* magazine (New York) printed a long and seriously philosophical discussion of the idea on Saturday, May 13, 1843.

But public mention soon died away. A dream lay buried for two generations. Newspaper commentators (circa 1910) recognized the similarity of Henson's *Ariel* with machines that were then flying. "Nothing new under the sun," was a common editorial lead. The London *Sphere* (September 12, 1909) printed a picture of the machine *upside down*, commented it was "exactly like the modern machine"! The similarities were more than coincidental.

That phase of Henson's work which rocketed into public notice in 1842 and sputtered out in obscurity when he left England in 1848 has been so well covered in aeronautical history that little will be repeated here. Henson and John Stringfellow signed a partnership agreement late in 1843. For four years they collaborated on the design and construction of two models that they hoped would fly. Both were steam driven. One (with a 20-foot span) followed the patent specification quite closely. Final attempts to launch it during the summer of 1847 on Bala Down, near Chard, were unsuccessful. The other, a modified design — smaller, more easily handled — was finally flown by Stringfellow in the summer of 1848. The detailed account of those years, however, is not for this story. Rather we have to deal primarily with portions of Henson's career which have hitherto been little known. Only lately, with the discovery of many documents and family records that have never been published, has it been possible to evaluate properly Henson's place in history.

Because so little was known of Henson, and because Stringfellow's career was more thoroughly documented by his contemporaries and by his son, F. J. Stringfellow, it is not too astonishing that Stringfellow alone was accorded the credit for the first flight of a power-driven model in 1848. As the figure of Henson emerges from its shadowy background, the fact is becoming more and more apparent that he should be given equal credit with his collaborator for the first step in the final



Henson's inventions ranged from razors to aeroplanes. This was an improvement on the common flyball steam-engine governor, patented in the United States in 1868.

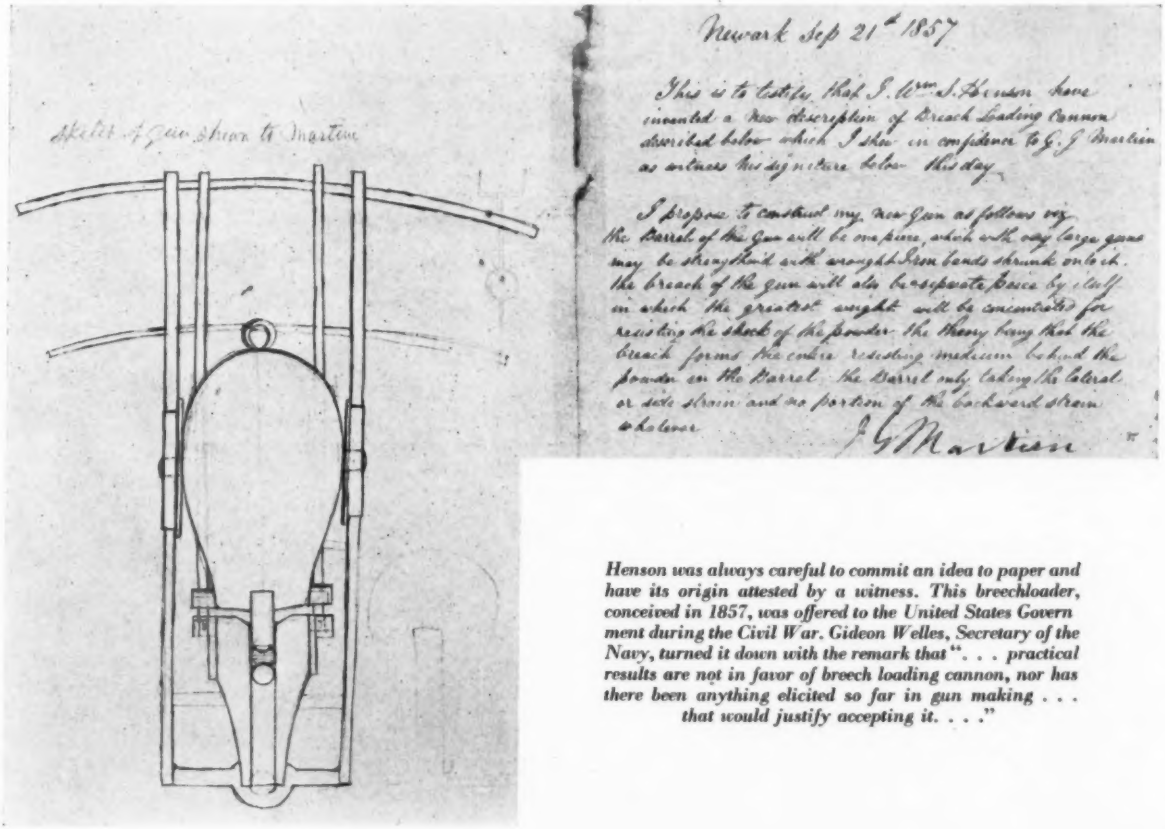
development of heavier-than-air flight, even though he was not present to witness the final triumph.

So far, many aeronautical historians have been either inept in research or downright lazy. The true facts of Henson's career have not been buried too deeply, yet everyone who has written about him has accepted without question the statements of one or two classic writers. Malcolm Ross, in an article on Henson published in *Sportsman Pilot* for July, 1930, provided a clue to the Lipsham family connection, but neither he nor any subsequent writer to date made use of the information. J. E. Hodgson, in his *The History of Aeronautics in Great Britain* (1924), gave considerable space to Henson's work between 1842 and 1848 but excused himself of comment outside that period by saying, "The writer has endeavoured in vain to obtain information as to Henson's early or later life." He continued the myth that "success . . . still seemed unattainable, and Henson, discouraged and impoverished, finally gave up the project, crossed to America a year or two later, and disappeared 'in the wilds of Texas from the ken of aeronautical science.'"

The disappearance into Texas may have been only an expression of the average Britisher's hazy notions of the North American continent more than a few miles inland from the Atlantic seaboard, or it may have had some foundation in fact. William Samuel Henson, however, never settled within a thousand miles of the plains of Texas. There is some hint that a half brother, Francis Webb Henson, may have gone to Texas. He did disappear westward, and in later years the family name turned up in the records of the Lone Star State. The connection, however, has never been established.

M. J. B. Davy, in his book, *Henson and Stringfellow, Their Work in Aeronautics* (1931), hit a little closer to the truth. He had very little to say about Henson's antecedents and work prior to 1842 except that he "is said to have been born at Leicester in 1805. . . . Of his early life very little is known." He says Henson married in 1848, emigrated to America in 1849, settled somewhere in the vicinity of Philadelphia, and died on March 22, 1888, in Newark, N. J. For that he gets only a passing grade. The place and date of death and the year of marriage are accurate, but the rest has served only to add to the general confusion. He missed the time and place of birth by seven years and some 20 miles. (Henson recorded in his diary that he was born in Nottingham on May 3, 1812, and married Sarah Anne Jones on March 4, 1848.) As will be shown presently, the acceptance of the 1805 birth date has introduced serious errors into certain assumptions that have been made regarding his career.

The alleged residence in Philadelphia can be disposed of readily. Early records of Philadelphia and Germantown disclose the arrival from Nottingham, circa 1858, of a William Henson and his wife Sarah. This man also came of a family of inventors, mechanics, experts in knitting and lacemaking trades, a fact that further misled researchers. For many years the name was associated with a flourishing textile manufacturing



Newark Sep 21st 1857

This is to Certify that I. Wm S. Henson have invented a new discription of Breach Loading Cannon described below which I shew in confidence to G. J. Martin as witness his signature below this day

I Propose to construct my new Gun as follows viz the Barrel of the Gun will be one piece which with any large guns may be strengthed with wrought Iron bands shrunk on to it. the breach of the Gun will also be a seperate piece by itself in which the greatest weight will be concentrated for resisting the shock of the powder the theory being that the breach forms the entire resisting medium behind the powder in the Barrel the Barrel only taking the lateral or side strain and no portion of the backward strain whatever

J G Martin

Skelet of Gun shewn to Martin

Henson was always careful to commit an idea to paper and have its origin attested by a witness. This breechloader, conceived in 1857, was offered to the United States Government during the Civil War. Gideon Welles, Secretary of the Navy, turned it down with the remark that ". . . practical results are not in favor of breech loading cannon, nor has there been anything elicited so far in gun making . . . that would justify accepting it. . . ."

business in Germantown. Some of this Henson's descendants still remain there. Although they all probably had an ancestor in common somewhere along the line, the Philadelphia story has nothing whatever to do with the saga of William Samuel. It is doubtful if either family knew of the other's existence.

The relationship between Henson and Stringfellow before and during the years of their active collaboration has never been entirely clear. So little has been known of Henson's early life, and the reason for the breaking up of the partnership is so obscure, that historians have arrived at their conclusions from very slender data. Since Henson's chronology has now been established, a more nearly accurate picture of the association between him and Stringfellow can be drawn.

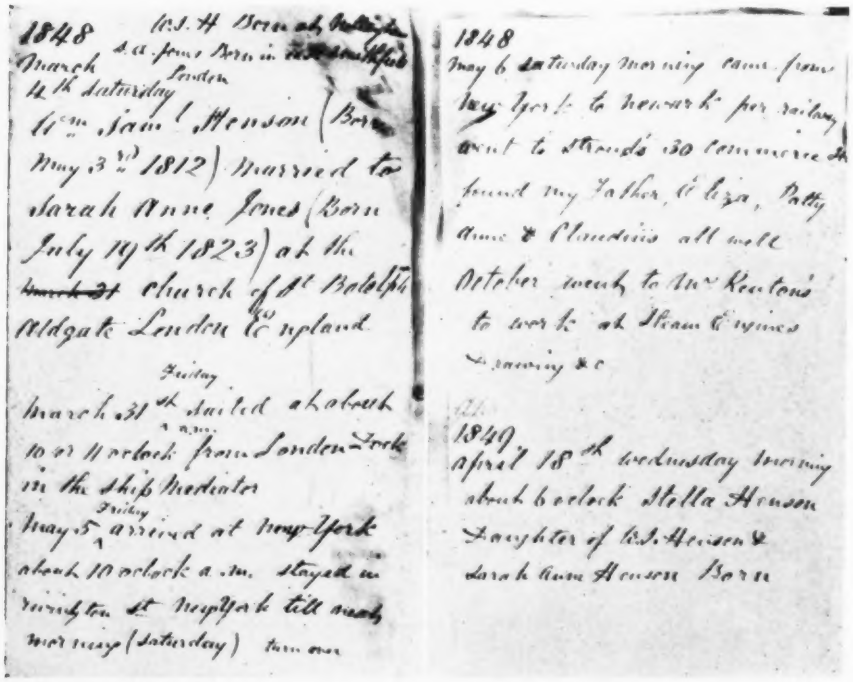
John Stringfellow was born in 1799 and moved to Chard in Somersetshire in 1820. His collaboration with Henson is stated to have begun when they met in Chard on Stringfellow's arrival. This theory now appears to be somewhat of an absurdity, because Henson was only eight years old at that time. Furthermore, it seems likely that the latter was then living with his family in Worcester and did not reach Chard until the early 1830's. Stringfellow, by then, had a well established business in Chard. Since both were mechanically inclined, it is not unnatural that the two men, the one in his early thirties and the other in his early twenties, should have been drawn together. The town was small enough to have made their meeting inevitable. Its population in 1831 was 5,141; in 1931, only 4,053.

That Stringfellow knew the Henson family long before he moved to Chard is not an impossibility. About 1812 to 1815 he was in Nottingham, apprenticed in the lace trade. At that time William Henson, Sr., was a burgess of the town. He was not only a prominent lace manufacturer but was recognized as an "inventive genius," having made a name for himself by the improvement of lacemaking and knitting machinery. It might even be that young Stringfellow had been apprenticed to him. In any case, it is not unlikely that when the Henson family turned up in Chard in the 1830's, Stringfellow came into contact with them again.

The exact date of the Hensons' arrival at Chard is unknown, but a letter exists addressed to "W. S. Henson, lace manufacturer, Chard," dated 10 July, 1835. On October 1, 1835, the British patent office issued to "Wm. S. Henson, machinist" at Chard, County of Somerset, letters patent for certain improvements in machinery for the manufacture of ornamented bobbin-net lace. Certainly young Henson and Stringfellow were both in Chard in 1835 and the chances are that their association began about that time.

It is a reasonable supposition that the complete idea for Henson's patent of 1842 did not spring full-blown overnight. Both the aerial steam carriage and the engine are so carefully detailed in the patent specification and drawings that it is fair to assume they are the end product of several years of thought and experimentation. Davy makes the statement that Henson was known to be "experimenting with gliding models, tentative constructional devices, and a light steam engine" in the year 1840. He must have been working and thinking about such things for several years before 1840, pondering the flight of birds, reading Cayley's articles in *Nicholson's Journal*, and discussing his germinating ideas for mechanical flight with his friend Stringfellow.

Stringfellow, moreover, from the height of his greater maturity and experience, may possibly have looked on such notions with amused tolerance. He certainly exhibited no great interest in flying (*Continued on page 432*)



1848 W. S. Henson born at Nottingham
March 14th Saturday
Wm. Sam.l Henson (Born May 3rd 1812) Married to Sarah Anne Jones (Born July 19th 1823) at the ~~March 31~~ Church of St Botolph Aldgate London England

March 31st Friday sailed at about 10 or 11 o'clock from London Docks in the Ship Mediator

May 5th Friday arrived at New York about 10 o'clock a.m. stayed in Irvington & New York till next morning (Saturday) turn over

1848
May 6 Saturday morning came from New York to Newark per railway went to Stranks's 30 Commerce St found my Father, Eliza, Patty Anne & Claudius all well

October went to Mr Keatons to work at Steam Engines Drawing &c

1849
April 18th Wednesday morning about 6 o'clock Stella Henson Daughter of W. S. Henson & Sarah Anne Henson Born

Two pages from the diary of William Samuel Henson which establish some dates hitherto uncertain.

Technical Force: Economic Stress

The Basic Influences of Technological Innovation on the Economy Emphasize Need for Freedom of Trade

By Ralph E. Freeman

PROGRESS in science and engineering has been, and probably will continue to be, the main cause of our rising level of living; yet technical novelties, like new shoes or a new set of teeth, may for a while be sources of acute discomfort. A new idea may disturb one's mental equilibrium by raising doubts as to long-accepted beliefs and by undermining cherished principles born of family and social tradition. "What is the question," asked Disraeli, "now placed before society with the glib assurance which to me is most astonishing? That question is this: Is man an ape or an angel? I, my lord, I am on the side of the angels. I repudiate with indignation and abhorrence these new fangled theories." Regardless of whether any important previously accepted scientific principles will be invalidated by wartime research activity, the new materials and techniques and the improved commodities and methods of production now being prepared in our research laboratories are almost certain to be disturbing when first applied. Whether the effect is to save labor or capital, to cheapen products or to improve them, or to create new articles which compete with those already in use, technical novelties upset established economic relationships and set in motion readjustments painful and costly.

By those whose interests were jeopardized, most of the important technological innovations of the past were received with "indignation and abhorrence." A few sentences from the National Resources Committee's report, "Technological Trends and National Policy," will bear out this statement. "The spread of block printing westward from China was checked by the opposition of the Islamic world. . . . The Koran was never printed in any Islamic country until a few years ago. The reason given was the belief that to touch the name of Allah with a cleaning brush made of hog bristles was blasphemy." "Turnpike companies profiting by tolls, and owners of stagecoaches were among the most active opponents of railroads. They were supported by tavernkeepers along the route of the roads, and by farmers who felt that the introduction of the railroad would deprive them of markets for horses and for hay." "One group of objectors declared that the use of gas would deprive Britannia of her ability to rule the waves, because by eliminating whale oil lamps it would destroy the whale oil industry, the nursery whence Britain drew her sons to man her fighting ships." "Beginning in Lancashire in 1776, and especially in 1779, there was a systematic attack throughout England on the use of new machines invented by Arkwright . . . which forced spinning out of the cottage into the factory."

Modern writers dealing with the economic effects of innovation emphasize the "frictions" and "rigidities" of the economic system. Trouble arises because the industrial system is not flexible enough to adapt itself readily to the alterations in costs and prices which result from technical changes. New cost conditions call for transfers of labor from one industry to another, for expansion or contraction in the output of various branches of production, for shifts in the location of industries, and for changes in the proportions in which labor and capital are combined. But because of the rigidity of the economic system, these adjustments are effected only with considerable difficulty and delay. Workers develop special skills and become rooted in particular regions. Capital in the form of durable goods cannot be disinvested and transformed, cannot be shifted into other areas except as the machines and the plants wear out over a considerable period of time. And these rigidities are in many respects becoming more intense with the progress of mechanization and the development of larger productive enterprises. The impact of the dynamic force of innovation upon the relatively fixed economic structure creates stresses and strains involving workers, investors, and the nation as a whole in serious loss of income. Indeed, the consequences may reach beyond the frontiers of the nation, creating significant maladjustments of an international character.

The smooth riding of a vehicle along a road depends on two conditions: the nature of the road's surface and the quality of the vehicle's springs. Technological innovation makes the surface of the economic road very uneven and, if we are to judge from predictions coming from "authoritative sources," there is little prospect of eliminating or diminishing the bumps. Since the shock-absorbing mechanism of the economic system is not so efficient as it might be, it looks as if we were going to be taken for a rough ride.

WHEN a new device reduces cost of manufacture by making possible the production of the same output with fewer workers, the industrial system is called upon to provide new jobs for the labor that has been displaced. This result is achieved largely through the spending of income released as a consequence of the cost reduction. If the reduction is followed by a decrease in the price of the product, the amount purchased (and produced) may increase considerably, necessitating the hiring of additional men. If, on the other hand, consumers fail to respond in this fashion and increase their purchasing of this article only very little, they will have income available to spend on other things. The

output of these other things can be enlarged only by the employment of more labor. Even though the price of the product does not fall, income will be released to provide additional employment, for profits will be higher and those who receive them will have more money to spend. In the last analysis, therefore, technological unemployment tends to disappear as the innovations increase the national income and production.

But the expansion of production may not require the services of the workers who were originally displaced. That is the crux of the matter. Even with an augmented demand for workers by the industry in which the innovation was first introduced, the demand may be directed toward men with different qualifications from those who originally lost their jobs. Cigar-making machines, for example, which caused the layoff of skilled workers, required operatives with relatively little skill, so that the old hands found themselves deprived of the advantages of many years of training and experience. Moreover, should the increased demand for labor appear in other industries, it may be directed toward workers who have entirely different capacities and skills. Under these conditions the displaced men will have to be re-educated for new occupations and, if their new jobs are located in another part of the country, the readjustment will necessitate geographical as well as industrial mobility. Even when the necessary shifts are eventually accomplished, unavoidable delays may create considerable temporary unemployment. Investigations have been made which indicate, as one would expect, that unskilled workers make the adjustment more quickly than do the skilled, and that the younger workers find new jobs more easily than do the older workers.

Whether the general expansion of output induced by technological progress will always suffice to overcome completely the effect of the reduced labor requirements in particular industries is a question to which no definite answer can be given. The fact that growth in total output during a given period in the past has not been great enough to absorb the unemployed is not conclusive evidence one way or the other. Nontechnological factors influence both employment and output. It is conceivable, however, that the increased output might require relatively less labor than was formerly used in production and that some readjustment of wages would therefore be necessary to keep at work the same number of men as before. Moreover, if technological improvements result in higher profits rather than in lower prices, the increase of production may be limited by delay on the part of corporations or their stockholders in spending the added profits. Hoarding is more likely to occur when the benefits of progress are passed to the profit receivers than when they are transmitted to the general body of consumers. However that may be, there is no doubt that adjustment to the employment dislocations which accompany technological change is a harsh and drastic process. The more numerous and the more revolutionary the changes, the greater the number of those who will be out of work.

Technical progress hastens the obsolescence not only of human aptitudes but also of industrial equipment. New firms armed with up-to-date productive apparatus are pitted against older ones which have not been able to keep up with the march of science and engineering. Though the firms with obsolete equipment have higher costs than have their more progressive competitors, the former may stay in business, finding that to accept a lower return on their investments is less unprofitable than to scrap their machinery and rebuild their plants. Hence the total productive capacity of the industry will be increased.

Two possible consequences of this situation should be noted: First, there may be overproduction. The amount produced may become so large relative to the market demand that the price of the product is depressed to a level which is profitable for few, if any, of the enterprises in the industry. Instead of being eliminated — and this, of course, is the desired structural readjustment — these high-cost, or marginal, producers are able to hang on, contributing to the output and exerting a downward pressure on the price. Such overproduction is wasteful of economic resources. In times of depression, of course, practically all industries will be in financial difficulties; but if the unprofitable condition of an industry is attributable not to general depression but to expansion resulting from technological change, a maldistribution of resources is indicated. This condition should be corrected by a movement of labor and other productive agencies out of the unprofitable sectors of the economy into others where resources are being used to greater advantage.

A second possible result of expansion in productive capacity is under-utilization. This condition arises when, by some form of monopolistic control, the output of the expanded industry is limited to an amount that can be sold at a profitable price. Under-utilization of plant and machinery is obviously wasteful. The community is deprived of the commodities and services which the idle equipment might be producing. Technological change, by enabling the industrial machine to turn out want-satisfying goods with less expenditure of materials and human effort, should result in a higher level of living, but this goal is missed to the extent that the new technology throws some of our productive equipment out of use.

Though a monopoly, through restricting the entrance of new firms into the industry, may avoid both overproduction and under-utilization, it does not thereby either stimulate technological progress or promote the proper distribution of our productive resources. To impede the entrance of new firms may delay the introduction of new techniques. Even when the concerns within the monopoly are quick to apply the results of scientific discovery, however, the price of the product will be higher than it would have been had no restrictions been imposed. The use of the product will be limited to those consumers who are able and willing to pay the higher price. In other words, the commodity is underproduced. Society does not receive the amount of this product to which it is entitled on the basis of cost of production. The high price resulting from pre-war restrictive practices in the aluminum industry, for example, is alleged to have prevented the application of this material to many uses that were economically justified. One of the primary (*Continued on page 452*)

Dr. Gatling and His Humanitarian Gun

A Case History from the 1860's Contrasts Sharply with Today's Attitude Toward Wartime Inventors

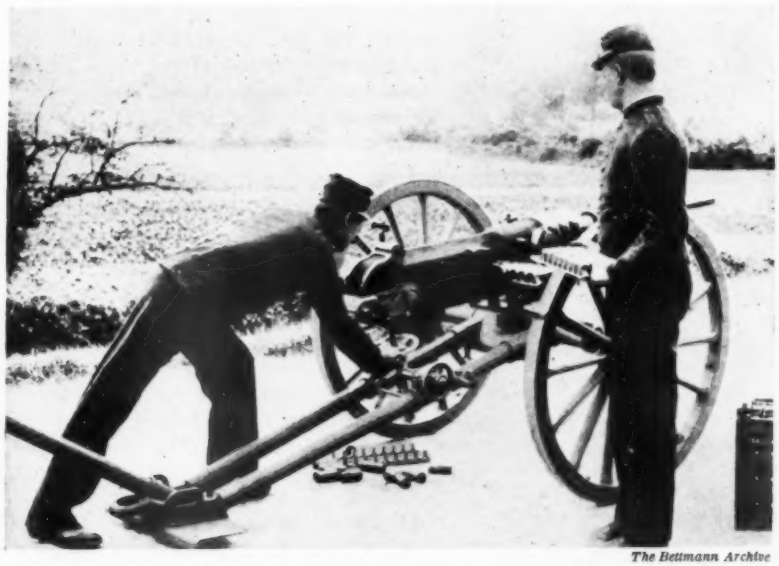
By George Fort Milton

THOUGH man is prone to error, a cynical philosopher remarked, he strives to avoid repeating exactly the same error that his grandfather made. Be this as it may, there is a refreshing contrast between the way the Federal Government treated new inventions in the Civil War and the attitude of the government today. In the Great American Conflict, surely the nation's sternest testingtime until today's struggle for survival, inventors and inventions were handled with scant courtesy by the Army's Ordnance Department. But in today's war, the government has gone to great lengths to mobilize the inventive talent of the nation. Backed by an appropriation of $73,000,000 for fiscal 1943, with $135,900,000 recommended for the next fiscal year, the Office of Scientific Research and Development, under Vannevar Bush ['16], illustrates this changed attitude. In addition, the War Production Board's Office of Production Research and Development, directed by Harvey N. Davis, is ably seeking new and improved materials for the production of goods for the war effort.

This situation represents a distinct improvement over that in Washington during the Civil War. The record of the administering of United States Army ordnance procurement during the first three years of that struggle is replete with instances of rebuff to inventions of great merit, employment of which by the Federal forces might have quickened victory. Consider the case of Richard Jordan Gatling and his later famous Gatling gun.

Gatling's forebears came to America about 1700 and established themselves in North Carolina. The inventor's father, Jordan Gatling, settled on the Meherrin River in Hertford County near Murfreesboro; he acquired some 1,200 acres of farmland and timberland and became a most successful planter. He had the inventive instinct and contrived a cotton-sowing machine. The son was born on his father's plantation at Manney's Neck on September 12, 1818. After a common school education, the boy began clerking at 15 in the Hertford County Court House. Four years later he opened a crossroads grocery store. Here, at the age of 20, he invented a screw propeller and tried to get a patent for it — only to find that the brilliant Swede, John Ericsson, had anticipated him. The following year, young Gatling devised a sort of steam drill for rice planting.

In 1844 he moved to St. Louis, where he first kept body and soul together by clerking in a St. Louis dry-goods store but spent all his spare time tinkering on his inventions. The first of a new series was a wheat drill, which he undertook to sell to the farmers direct. These parallel abilities to invent, promote, and sell marked the rest of Gatling's career. The wheat drill, for instance, he would take out to a wheat farmer and persuade the latter to make a practical deal: The farmer would set aside a part of his land for the employment of the new device. On half he would sow wheat by the old hand-planting fashion, while on the other half the planting would be done with Gatling's drill. The inventor then would take the excess wheat produced upon the machine-planted half over that of the hand-planted half, as first payment on the drill.



The Bettmann Archive

A medium-sized version of Dr. Gatling's humanitarian gun mounted on a field carriage, as an old photograph recorded it

This career of selling the wheat drill to the sons of the soil brought the next great change in Gatling's career. While on a steam packet going from Cincinnati to Pittsburgh in 1845, he was stricken by smallpox. He almost died from it, and on his recovery he determined to learn something about the art of medicine. With that in view, he entered the Indiana Medical School and then took a further course at the Ohio Medical College in Cincinnati. But

though Gatling was graduated as a doctor and was always so styled thereafter, he practiced very little. He moved to Indianapolis, married there, and carried on his experiments on all manner of machines.

Soon after the outbreak of the Civil War, Dr. Gatling began to meet the trains that came to Indianapolis bringing wounded and some dead from battlefields and camps. His examination of the dead revealed that only about a sixth had succumbed to bullet wounds but that the great majority had come to their end because of epidemics, fevers, dysentery, pneumonia, and other natural diseases incident to camp and campaign. Gatling deemed this a strange waste of soldier life, and his chain of thought led to the conclusion that if a better weapon were available, military combat could be decided with greater promptness and that therefore fewer men would die in war. In response to this initially humanitarian impulse, the physician-inventor set himself to the task of contriving a gun to shoot more bullets, to kill or wound more enemy soldiers, to shorten war.

Some of his spare time in 1862 was put on the invention of a naval ram; by the late summer, however, his ideas for a new rapid-fire gun had taken shape and the first model was ready for demonstration. It was a brilliant improvisation, a combination of existing devices — but the very first machine fired over 200 rounds a minute. This capacity represented an amazing enlargement of the fire power of the infantry small arms of the day, just then in transition from muzzle-loading to breech-loading type.

In September, 1862, Gatling demonstrated his new weapon at Indianapolis before a mixed group of Army officers and civilians. Next he commissioned the machine shop of Miles and Greenwood in Cincinnati to build six Gatling guns to his specifications. There ensued the usual story of delay and disappointment. Miles and Greenwood's machine shop burned to the ground, and the first machine guns were destroyed. The inventor persisted; at length a new gun was turned out; and in October he took it to Washington to put through his application for a patent and, even more important, to sell the new gun to the Ordnance Department of the United States Army.

Gatling knew the ropes at the Patent Office, and on November 4, 1862, there was issued to him Patent No. 36,836, entitled, "Improvement in Revolving Battery Guns." The object of the invention, he stated, "is to obtain a simple, compact, durable, and efficient fire-arm for war purposes, to be used either in attack or defense, one that is light when compared with ordinary field-artillery, that is easily transported, that may be rapidly fired, and that can be operated by few [*sic*] men."

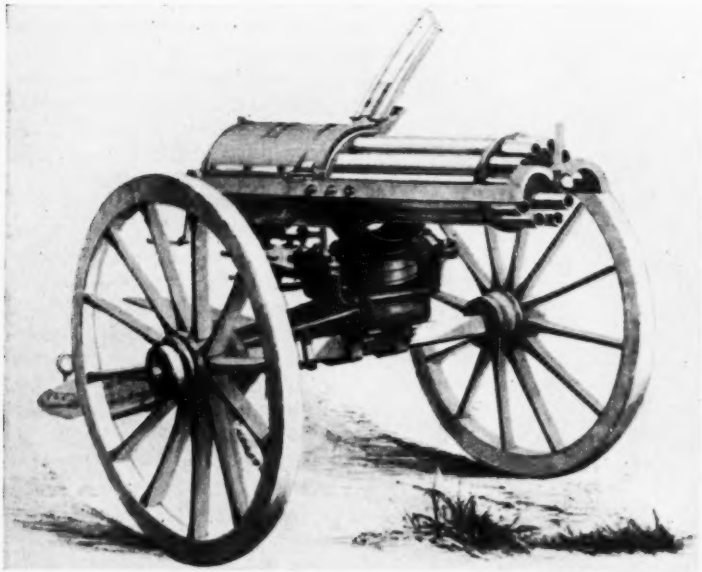
The patent application went on to describe the technical principles involved. "The invention," it related, "consists in a singularly-constructed revolving lock cylinder or breech, in combination with a grooved carrier and barrels all rigidly fixed upon the same shaft, and all of which revolve together when the gun is in operation, the locks and grooves in the carrier and the barrels all being parallel with the axis of revolution."

It also claimed invention "in the novel means employed in cocking and firing the gun without the use of a trigger by means of the inclined plane on the rear edge of the ring, which surrounds the forward end of the lock cylinder." In addition, Gatling emphasized the novelty in use of the "inner tubes" which contained the locks, "to press the cartridge-chambers firmly against the rear ends of the barrels while being discharged, and in the outer casing and disk, which protects the locks from injury."

His ease in getting the patent was no harbinger of success with the Ordnance Department. Here Gatling was given the well-known run-around, principally because of the dotage of the chief of ordnance of the Army. This was Brigadier General James Wolfe Ripley, who had been born in 1794, had been graduated from West Point in 1814, and who was participating in his fourth war.

Apparently he had already had his fill of inventors, humanitarians, and other disturbers of his paper-work routine. When Gatling asked a hearing on the merits of his new weapon and an actual trial and test, the general declined. He was much too busy fighting a war to be bothered with inventors' experiments! That such a man could have been in charge of Army ordnance — particularly at such a crucial time — seems amazing, yet he continued chief until August, 1863.

At any event, Gatling left Washington for Indianapolis a greatly disappointed man, but at Baltimore he ran into Major General Benjamin F. Butler, to whom he poured out his tale of woe. Butler, just back from his exploits at New Orleans, took an active interest in Gatling's invention and himself placed an order for a dozen of them which were to be used by his own command. (*Continued on page 444*)



The Bettmann Archive

Embodiment of Gatling's effort "to obtain a simple, compact, durable, and efficient fire-arm for war purposes" was this ten-barrel, one-inch gun.

The Dilemma of Sympathy

Psychic Environment of the Worker Must Be Reckoned with As a Factor in Production

By Paul Cohen

"PEOPLE don't seem to understand you got feelings. When you work and fight together for a long time you hate to split up. It's like something going out of your life." That was the reported reaction of a pilot in the late American Volunteer Group in China (the Flying Tigers) when he learned that the organization was being disbanded and that most of its members were to be absorbed by the United States Army Air Forces. Like a good officer, he probably swallowed his disappointment quickly and went to work with all his abilities under the new conditions. But more graphically than most men ever do, he had described the first and often lasting feeling of resentment that most of us have experienced when some move made without our knowledge or consent has ruined plans, separated friends, or injured prestige.

Certainly military forces cannot make formal provision for soothing injured feelings when issuing orders or changing organizations, but, on the other hand, they are acutely conscious of the importance of individual and group attitudes. In marked contrast to industry, military organizations have long had an extensive and frequently used vocabulary to describe such attitudes: morale, *esprit de corps*, spirit, confidence, *élan*. To control these attitudes, they also have many and ancient traditions: concepts of duty, obedience, loyalty, and, on the reverse side, impartial justice, and reward and honor for outstanding performance. This preoccupation with intangibles is justified by the decisive effect they often have on results.

The saying, "The moral is to the material as ten to one," is attributed to Napoleon. By a somewhat roundabout route, industry is reaching substantially the same conclusion. Increasingly, the study of industrial fatigue, the term which has come to cover everything tending to reduce worker output, be it absenteeism or sunstroke, is stressing that the worker's mental state rather than his physical surroundings is the determining factor in production. Thus, air conditioning, fluorescent lights, tiled showers, or the prospect of steady employment will help in keeping a labor force contented, but they will not help nearly so much as a general feeling that the foremen are honest and competent or that promotions will follow with some certainty after the demonstration of the required ability. It may be added that such feelings are not now conspicuously widespread among labor.

When large-scale investigations into the factors influencing the efficiency of labor were started during the first World War in Great Britain, Germany, and the United States, an unexpected and enormous demand for munitions, to which the first reaction had been longer hours, had stressed labor so much that physical exhaustion, accidents, and absenteeism were assuming the aspects of national problems. Attention quite naturally turned first to the physical factors, for here were many obvious conditions which even a semienlightened selfishness could not countenance. How long should the work week be? was one of the first questions asked. How much could a worker lift and how often? What went on in his muscles as he grew tired? How warm should the working space be and at what humidity? This conception of fatigue was one which industry could readily understand and act upon. Machines and materials performed best under certain conditions, which were discoverable by logical and objective study. Why not people? Management came to realize that noise could affect output; that it pays to give a draftsman, or for that matter a carpenter, all the light he needs; that there is an important relationship between diet and efficiency.

By and large, industry has quite willingly accepted the responsibility for maintaining good working conditions. Whole mines are now air conditioned. Vitamins are fed to workers requiring particularly keen vision, and salt capsules to those working in extreme temperatures. The task of manufacturing such items as safety goggles and gas masks has become a fairly good-sized industry in itself. An African copper-mining company found that when its native help were fed a balanced diet — the first time in their lives that these men had ever enjoyed such an experience — their resistance to disease and their working capacity were almost doubled. It may also be pointed out, without belittlement, that an intelligent dairyman will do as much for his cows. As the literature on industrial medicine indicates, interest in the worker's well-being has now extended far beyond the control of industrial hazards and even beyond the confines of the factory. Nevertheless, one may assemble an imposing list of managements that, after providing good rates of pay and adequate working conditions, and after exhibiting what seemed to them a sincere interest in their personnel, have still failed to gain the co-operation of the employees, who have grumbled, or slowed down, or deliberately walked out in strikes disastrous to both sides. Somehow the basic causes of discontent had been left untouched.

Perhaps, as F. J. Roethlisberger suggests in his *Management and Morale*, the root of the trouble is the "oversimplified theory of human motivation" to which industry holds, at least officially. "An industrial organization is assumed to be composed of a number of individuals entering into relations of contract for the promotion of their own individual economic interests." If a man is, therefore, paid according to the value of his

job and at a rate to which he formally agrees, if he is not overworked, and if he is given safe and comfortable surroundings, he should be happy. Except that, quite frequently, he isn't. The pay envelope may take care of economic man, but there is also man the social animal, who needs the liking and respect of his fellow men, including his superiors; who nurses ambitions and hopes of leadership; who resents unfair or callous treatment even about the trivia of existence; and who wants, though often unconsciously, the feeling that his work is necessary and that he has a secure and definite niche in the social structure. At the end of an article in a technical magazine on the manufacture of a molded-plastic antenna housing was a paragraph stating that production almost tripled when the employees learned (and not through their employers) that their housing was being used on most American bombing planes and that it had been carried by the planes which made the first bombing raid on Tokyo.

Intangible incentives are scarcely a recent discovery, since they have been among the main factors in making armies, churches, and governments function over longer periods and under more difficult conditions than most industries can claim. Nor are they secret even to industry. But as industries have grown in size and as the formal organization has submerged individual personalities and complaints, the tendency has been to lose sight of the fact that man is many other things besides a logical, reasoning being. Few trends during the past decade appear more significant to the future of labor relations than the upsurge of interest in, and objective investigation into, the social and psychological problems of the worker.

As a note on the general knowledge of the effect of the worker's mental state on his output as it existed in 1927, it may be illuminating to relate how in Chicago the Hawthorne plant of the Western Electric Company began the now classic series of experiments which it carried on between that date and 1932. In line with a long-continued policy of providing good working conditions for its employees, the company, in collaboration with the National Research Council, undertook a study to determine the relation between intensity of illumination and efficiency of workers, measured in output — seemingly a straightforward experiment on the physical aspect of fatigue. But the investigators (could it be that they were more thorough or at least more skeptical than some of their predecessors?) found no clear-cut relationship. Output went up when the illumination was raised for the test group. It also went up for the control group whose light level was held constant. Output also went up when the group under test was told that more light was being provided, although the light intensity was actually not changed.

Other such puzzling results have been reported. In one case, a group of women workers in a textile mill were given a short rest pause twice a day, and their output was measured. It increased. When the workers were returned to the original conditions as a check, however, output remained at the higher levels. The investigators began to realize that their subjects, far from being static elements in the experiment, were themselves reacting on the situation in a manner which totally obscured the effects of the variables which the investigators fondly thought they were controlling. The women liked their new role; they enjoyed the attention paid them by the investigators and the interest shown by the other workers. No doubt they appreciated the thought being given to their personal comfort. Thus stimulated, they devoted a new attention to their work, and although making no conscious attempt to speed up, they succeeded in raising their production. As the Hawthorne observers put it, the laboratory technique of varying one element at a time was impractical if not impossible; it was necessary to study the phenomena *in situ* as do the doctor and the biologist most of the time, paying due attention, in fact paying most attention, to the motivation, social relations, and emotions of the worker rather than to his physical surroundings.

No more or less than any other human being, the industrial employee exists not only in a physical world of matter and energy but also in a psychological and social environment — his private worlds — and in this country at least, where working conditions have by and large advanced to the stage where major physical obstructions to good performance have been removed, changes in these private worlds have outstanding effects on efficiency. For instance, during the five years it was under observation, the relay assembly group at the Hawthorne plant continued to increase output more or less steadily until it was 30 per cent above the starting point. Yet, according to the book, (*Continued on page 438*)

American Bridge Company

Apprentice welders at work under the supervision of a training instructor

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Medalist

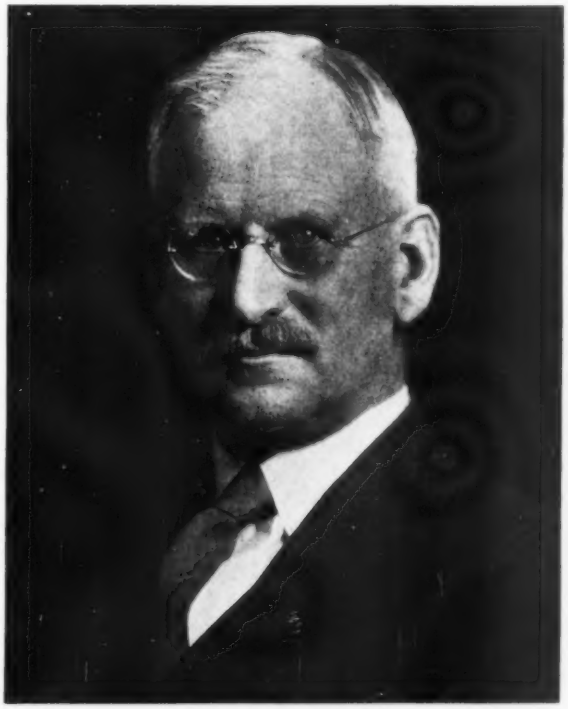
FOR outstanding contributions to the field of food technology over a period of many years, the Nicholas Appert Medal is being awarded this month to Samuel Cate Prescott, '94, Professor of Industrial Biology, Emeritus, and former Dean of Technology's School of Science. The medal was established in 1941 by the Chicago section of the Institute of Food Technologists, and the medalist is chosen by a jury of distinguished technologists representing various divisions of the food-processing industry. Eligibility for the award is based on pre-eminence in the field of food technology and on contributions to the progressive development of food manufacture and processing.

Dr. Prescott's notable career in food research began while he was still an undergraduate at Technology, when he started investigations on the chemistry of foods. His earliest contributions included methods of safeguarding the purity of milk supplies, the advancement of techniques for canning meat, and purification of water by chemical compounds.

As a division chief in the United States Department of Agriculture and later as an Army officer, Professor Prescott was active during the first World War in the development of methods for dehydrating food destined for shipment to our forces overseas. After the War he devoted himself to an exhaustive study of the application of low temperatures for food preservation, an investigation which led into the field of quick freezing. During the formative years of this new industry, his technical counsel had an important bearing on the solution of many problems.

Since his retirement last year, Dr. Prescott has been a consultant to the dehydration committee of the United States Department of Agriculture as well as to the research laboratories of the National Canners Association.

It was as dean of the School of Science and head of the Department of Biology and Public Health that Professor Prescott in 1937 sponsored the first international Food Technology Conference, which was held at M.I.T. In June, 1939, when the conference again came to Technology, the Institute of Food Technologists was established. In recognition of his contribution to food technology and the success of the conferences, Dr. Prescott was elected the first president of the Institute of Food Technologists and is now a member of its council.



Samuel C. Prescott, '94

By Ballot

OFFICERS to serve the Alumni Association for the year to come, as elected in recent balloting, are: Francis J. Chesterman, '05, President; Raymond H. Blanchard, '17, Vice-president for two years; James A. Cushman, '03, and Alf K. Berle, '27, members of the Executive Committee for two years. Walter J. Beadle, '17, Donald F. Carpenter, '22, and Francis A. Barrett, '24, have been elected members of the Institute Corporation for five-year terms, and Irving W. Wilson, '11, has been elected to the Corporation to complete the term of the late Alfred H. Schoellkopf, '15. The contest for membership on the National Nominating Committee eventuated in the election of Samuel C. Prescott, '94, to represent District 1; Orville B. Denison, '11, District 2; Lauren B. Hitchcock, '20, District 4; and Frank Maguire, '17, District 5.

Chosen representatives of their respective classes on the Alumni Council were Samuel S. Dearborn, '84, William W. Lewis, '89, Samuel C. Prescott, '94, Miles S. Sherrill, '99, Eugene H. Russell, Jr., '04, Arthur L. Shaw, '09, H. B. Richmond, '14, George W. McCreery, '19, Francis A. Barrett, '24, Eric A. Bianchi, '29, Henry B. Backenstoss, '34, and Robert C. Casselman, '39.

Men and Metals

ELECTION of members of standing committees was prominent in the business of the 232d meeting of the Alumni Council, held at the University Club in Boston on the last Monday in April. Speaker of the evening was Robert S. Williams, '02, Head of the Department of Metallurgy and Deputy Dean of Engineering at

Reunions in June

Several Institute classes held their reunions for 1943 during the Alumni Day festivities in January. Others have plans for meetings this month, the schedule being as follows:

1888 — The Country Club, Brookline, Mass., June 7
1893 — The Country Club, Brookline, Mass., June 5
1903 — Somewhere between New York and Boston, June 25 to 27
1908 — Oyster Harbors Club, Osterville, Mass., June 18 to 20
1918 — Weekapaug, R. I., June 18 to 20

the Institute, who surveyed recent developments in metallurgy and discussed some of the probable future applications of them. In the absence of President Francis A. Barrett, '24, Harold Bugbee, '20, Vice-president of the Alumni Association, presided at the meeting. The role of Charles E Locke, '96, Alumni Secretary, who was kept away by illness from the first meeting which he had missed in over a decade, was performed by Ralph T. Jope, '28, Treasurer.

To the Committee on Historical Collections, Robert P. Bigelow, Professor of Zoölogy and Parasitology, Emeritus, was elected for five years; to the Committee on Audit and Budget, H. Leston Carter, '08, for three years; to the Committee on Honorary Members, Edward S. Chapin, '98, for three years; to the Nominating Committee for Departmental Visiting Committees, Bernard E. Proctor, '23, and Royal B. Wills, '18, for three years; to the Alumni Fund Board, Edward Pennell Brooks, '17, for five years. The Assemblies Committee — consisting of Larcom Randall, '21, chairman, John T. Rule, '21, James Donovan, '28, and Robert C. Casselman, '39 — were re-elected for one year. Nominees for re-election to departmental visiting committees for two years were presented by Mr. Bugbee, and re-election of them was recommended to the Corporation.

Reporting informally on the work of the Committee on Historical Collections and of the Alumni Fund Board, H. B. Richmond, '14, chairman of the two organizations, said that the first has found war conditions a serious bar to the continuation of its normal activities, but that the committee is most fortunate in that Miss Julia M. Comstock is assembling and correlating historical material for future use. The Fund Board, Mr. Richmond reported, is gratified by the fact that in the three years of its life, the M.I.T. Alumni Fund has grown to be the fifth largest in the country. Commenting on the able work of Henry B. Kane, '24, Director of the Fund, Mr. Richmond urged Alumni to continue their efforts toward the goal of 10,000 contributors and $150,000 in contributions.

Dean Williams, describing the rapid advances being made in the science of metallurgy as a result of the necessity for securing satisfactory alternative materials for many of the strategic metals now urgently needed for war work, surveyed various practical developments which have thus come about. New techniques for the hardening of steels and the devising of methods of precision casting were among the important advances which he discussed.

Citing the use of powders under heat and pressure to make many small gears and sleeves, Dean Williams declared that the development of powder metallurgy has aided the war effort to a very great extent through the saving of valuable time in machine-shop operations. The willingness of industrial organizations to contribute men, money, and materials for the perfecting of new alloys, Dean Williams said, has contributed notably to the effective prosecution of the war.

Visiting Committee Report

THE Committee on the Department of Electrical Engineering * met in New York on January 26. Also present at the meeting were Edward L. Moreland, '07, Dean of Engineering; Harold L. Hazen, '24, Head of the Department; Carlton E. Tucker, '18, Professor of Electrical Engineering; and James R. Killian, Jr., '26, executive assistant to President Compton. The lengthy discussion, which reviewed the problems of the Department in considerable detail, is here summarized.

The Committee were informed that Professor Hazen had been appointed chief of division 7 of the National Defense Research Committee and that Professor Tucker is now executive officer in active charge of the Department. There is a nominal teaching staff of 75 in the Department. Of these, 20 are on leave of absence or are working almost full time on war activity. The extent of this war work, both in a consulting and in a research capacity, is most extensive and indicates the abilities of the staff, who are looked to for expert assistance by the Army and the Navy, the National Defense Research Committee, and others. The Committee noted with great satisfaction the reliance which is placed upon these men, indicating the high regard in which the Department is held.

The absence of many of the high-ranking members of the teaching staff has thrown a considerable load on the balance of the staff, but the younger men are carrying on effectively. The individual load is heavy, but there is no indication that the present procedure is not satisfactory. One of the problems of the Department was the uncertain size of the freshman class, making the required number of instructors difficult to determine.

Some senior and many graduate students are doing research connected with the war effort. Each student works as one of a group and writes up some one phase of the project. Thesis credit is given for this group research, in place of the usual required individual investigation. Present indications are that this procedure is quite satisfactory and has the advantage of impressing upon the student the importance of being able to work as one of a team.

* Members of the Committee for 1942–1943 are Francis J. Chesterman, '05, Chairman, Harry P. Charlesworth, '05, Harold S. Osborne, '08, Philip H. Chase, '09, Vannevar Bush, '16, Lee A. Du Bridge, and Reginald E. Gillmor.

The study made last year relative to broadening the power option to include more electronic applications resulted in the development of a new option, electronic applications. This option, started last June, is now in full operation and filling a real need. Further consideration should be given to the need for modification and broadening of the power option, but the progress made so far is in the right direction. In addition to the new option, three subjects have been inaugurated for special wartime needs. These subjects are designed to fill the demands for electrical engineers especially trained in electronics and in ultrahigh-frequency techniques. The course in ultrahigh-frequency techniques had approximately 75 men and was expanded to include the first and second terms of the fourth year, and for the Class of 1944 it has been extended to include three terms. Another of these new courses is instrument electricity, primarily designed for students not majoring in Electrical Engineering. These students are made more valuable to the war effort because of this course. The third subject, elements of electrical communications, is also primarily designed for students outside of the Department who will receive commissions in the Signal Corps. It presents the fundamentals of electrical transmission.

Because of draft regulations, work assignments in the co-operative courses have been regretfully abandoned for the duration because of the difficulty of carrying on outside work in present circumstances.

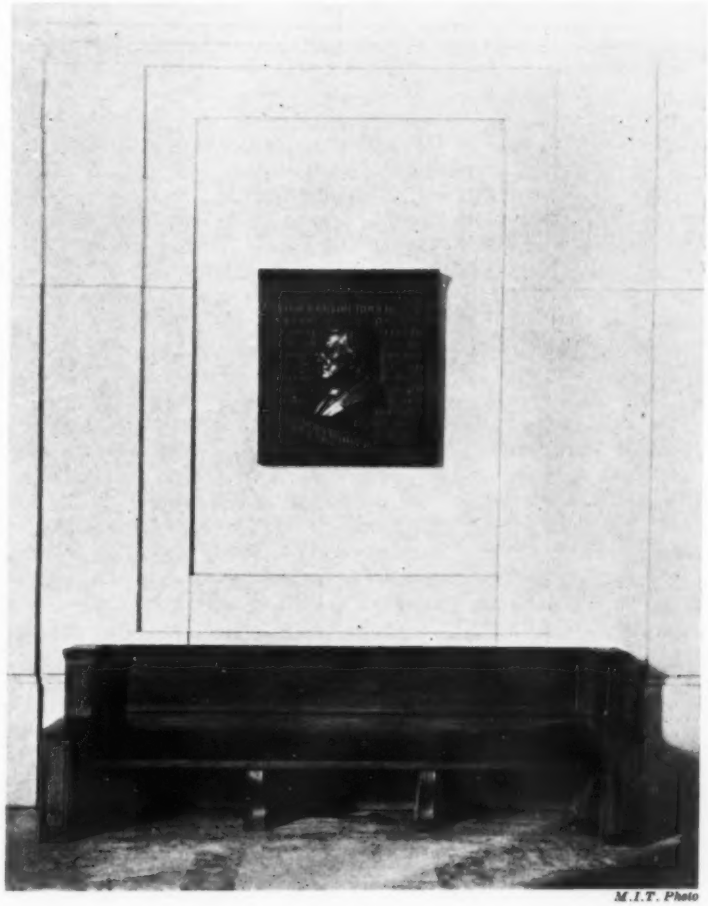
A great deal has been done in ultrahigh-frequency, particularly in the development of apparatus and teaching material for about 70 engineering schools. The Department, in addition, is supervising the construction of the necessary equipment for about 20 to 25 of these schools. Louis F. Woodruff, '18, Associate Professor of Electric Power Transmission, and three others have completed a new book, entitled, *Ultra-High-Frequency Techniques*. Approximately 14,000 copies have already been sold.

Working on a co-operative basis, the Department has completed three volumes of electrical engineering texts. These books, published by the Technology Press in conjunction with John Wiley and Sons, Inc., are especially valuable from many standpoints. Not only are they worth while in themselves but the writing of them has developed much useful material in circuit theory, magnetic fields, and their applications. In the discussion of these matters interdepartmentally, still closer co-ordination has arisen between the Electrical Engineering and the Mechanical Engineering Departments, which has been of benefit to both Departments.

After reviewing some of the material given by the Department, the Committee felt that further instruction in tube design — especially tube designs suitable for mass production with uniform characteristics — might be of value. The same recommendation was made for transformer design. While this subject is covered somewhat in the course in electrical implementation, the suggestion was made that the approach to be utilized in the further work might be from a synthetic rather than from an analytical point of view.

It was apparent that in the immediate future the Department would be called upon to teach advanced courses in communications to the Army and Navy men. The Committee felt it desirable for the Department to develop these courses and such others as were indicated to be especially valuable, and recommended that the staff be used for this purpose to the maximum possible extent. The Committee thought it would be wise in the development of these courses to specialize on the advanced work which the Department is well qualified to do — but only to the extent that the job can be well done.

The Committee expressed appreciation of the frankness and thoroughness with which the members of the Faculty discussed the problems and the outlook for the Department. They recorded their approval for the thoroughly sound methods which are being used in approaching various problems and for the results that have been obtained.



The memorial tablet to William Barton Rogers, founder of the Institute, in the rotunda of the building which bears his name

M.I.T. Photo

GRANDFATHER OF FLIGHT

(*Continued from page 422*)

prior to the year of Henson's patent application. Then, carried along by the enthusiasm of the moment, and probably absorbing from Henson more and more of the realization that success might be within their grasp, he fell in completely with Henson's ideas and later lived to reap the lion's share of the credit.

Latterly, three hitherto unknown letters from Stringfellow to Henson have turned up. They were written between April and July of 1845. (At that time Henson was living in London, Stringfellow in Chard.) They discuss many of the details of the construction of the models and the engines then under way and also disclose certain of the business arrangements between the partners. Regardless of their content, their tone is significant. They are not the letters of a master disclosing his ideas to a pupil. In spite of the age difference between the two men, the letters are rather those of an assistant toward his superior. Ideas are advanced with figurative question marks, and Henson's advice on this or that point is sought. The letters indicate certainly that Henson was the leader both in technical and in commercial matters.

On the business side, one point of interest comes out. When Henson and Stringfellow made their joint partnership agreement in December, 1843 (after the failure of the Aerial Transit Company), history records that they bought out the shares of their erstwhile partners, Frederick Marriott and D. E. Columbine. In a letter of July 25, 1845, however, Stringfellow wrote to Henson: "I received two notes from Marriott . . . in the one received this morning there was a proposition which I give you under and to which I believe Columbine is agreeable, that is to divide the patent interests into 12 — as follows Henson 4/12 Columbine 4/12 Marriott 2/12 Stringfellow 2/12 — this Marriott thinks equitable and just. I refrain from giving you my opinion on the subject as I should wish your opinion on it candidly and unbiased. He also purposed a meeting same as you mentioned in your letter and wishes my answer per return of post but of course I shall give him no answer till I hear from you."

Heretofore the belief has been that the Henson-Marriott-Stringfellow-Columbine syndicate was terminated with the failure of the company late in 1843. Actually, two years later, the group was still arguing over the distribution of the assets. Moreover, the letter gives some clue to the relative importance of the contributions of the four partners. Apparently Columbine's work as a promoter put him on an equal footing with the inventor, whereas Marriott (the lobbyist) and Stringfellow (the technical assistant) had to be content with only half as much each. All evidence indicates that the basic ideas for both the aeroplane and the engine were Henson's. Stringfellow's contributions — at least until the end of the 1840's — now appear to have been largely those of a constructor working under the general direction of the inventor.

It seems probable that Henson played a much larger part in the design and construction of the successful power-driven model aeroplane than history has accorded him. From the letters the fact is clear that two models were under construction as early as 1845. Stringfellow wrote in July that year: "I am not waiting for the silk as I have done nothing to the second pair of propellers for the large machine and am sorry to say I have been otherwise employed for the last week, that is, in repairing a Disaster. Last Monday week in the morning I found the trap fallen on the floor one of the cords having broken in two at a point where there appeared to be a little iron mould. Like all other bad jobs it might have been worse. I dont find any damage done to the frame work of the Machine, only the Boiler broken from its bearing and the dome and steam gague bulged a good deal. I had the frame and propellers of the small machine underneath it at the time which was literally smashed to pieces and I have now been spending my time for more than a week on it. I have succeeded in making it full as strong if not quite so light and neat."

Frederick W. Brearey stated in the *Popular Science Review* in 1869 that the successful Stringfellow flying model of 1848 was begun in 1846, some two years before Henson's "disappearance." The records of the unsuccessful experimenting on Bala Down during 1846 and 1847 indicate that the *larger* model was used throughout. The final modification of the *smaller* model and its power plant must have been carried out during the latter part of 1847 and the spring of 1848.

According to F. J. Stringfellow ("A Few Remarks on What Has Been Done with Screw-Propelled Aero-Plane Machines from 1809 to 1892" — Chard, 1892), the first successful flight of the smaller model took place in June or July of 1848, or within three or four months of the time of Henson's departure from England. Stringfellow probably worked out the launching method (clearly his own idea and one which undoubtedly contributed an essential element to the successful flight) during the spring of 1848, but in view of the length of time that it took in those days to develop and test engines, boilers, propellers, and so on, it is reasonably certain that Henson had a considerable hand in the actual construction and testing of the smaller model, which finally flew.

The histories state that he gave up in 1848, implying that he slunk off the stage to vanish in America. Why — when success was so close at hand? He doubtless had other reasons aside from discouragement over the problems of mechanical flight. In almost 10 years of aerial experimentation he had probably let his lace-making business go completely to pieces. How he managed to keep going that long is still a mystery — although his father undoubtedly had a hand in the business. Now the son was contemplating marriage, and surely little financial return seemed likely from the abortive experiments on Bala Down. His father is known to have been living in America at the time and had probably urged his son to come out and to take advantage of the opportunities of the New World. Further, the family records hint of a violent quarrel with Stringfellow. When it occurred and over what issue are still unknown, but Henson's opinion of Stringfellow in his later years made such an impression upon several of his children and grandchildren that two generations

(*Continued on page 436*)

Every wife is still a bride-to-be

AT the end of the war American wives will want to be brides all over again, start housekeeping afresh, refurnish their homes and refurbish their lives with sparkling new possessions for happy living. Not only new articles to replace the old and worn, but entirely new models that make it more fun to keep house. Automatic kitchen equipment, electrical appliances that make better waffles, coffee, toast . . .

Paradoxically, in an era of plenty, the manufacturer's chief problem may be materials. Not because there will be too few, but because there will be so many!

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For impartial answers to questions about metals, industry can turn to Revere. For just as industry in the future will not be restricted to the traditional materials, neither will Revere. In addition to widening still further the uses for copper and its alloys since the start of the war, Revere has developed facilities for manufacture of the light metals, and is pioneering in the production of wholly new alloys that can cut manufacturing costs for many industries.

Today the copper industry is producing only for war. No copper is available for anything else. But post-war planners with specific problems in metals are referred directly to the Revere Executive Offices in New York.

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ARMY (E) NAVY

Webster
Steam Heating

GRANDFATHER OF FLIGHT

(*Continued from page 432*)

later they clearly remember that the name "Stringfellow" was forbidden in the Henson household and that William Samuel took frequent occasion to denounce his former partner as one who had robbed him of his ideas and who had taken credit for them.

For whatever the reason, Henson broke off his work, married, and emigrated to America, where he subsequently lived for 40 years. Heretofore, no one has been exactly certain as to the date of his departure for America; his diary states, "Friday, March 31st [1848] sailed at about 10 or 11 o'clock a.m. from London Dock in the ship Mediator. . . ."

He landed in New York on Friday, May 5, 1848; went directly to Newark, where his father was already established; and settled down to the business of raising a family and earning a living. On the whole, he was more successful at the former than the latter. He and Sarah had seven children, five of whom survived early childhood — one of whom is still alive. Henson became a citizen of the United States on November 8, 1853.

The directories of the city of Newark, beginning with the issue of 1850 down to that of the year of his death, 1888, carried continuous record of his residence there. (The names of his widow and some of his sons and daughters appeared as late as 1907.) Henson classed himself variously as "engraver," "mechanical draftsman," "artist," and "civil engineer." During the 1850's he worked for a time for the Newark Machine Company and for one year listed himself as the "William S. Henson & Co., Machinists and Engineers, Union Building, Corner of Mulberry and River." Evidently this venture was short lived. The following year, he appeared simply as "Draftsman, Newark Machine Company."

From 1867 on, he listed no business connection. He considered himself a consulting engineer, an enterprise that was not always profitable. There were times when his family was said to have been in somewhat straitened circumstances. At one period, probably from the spring of 1864 to late in 1866, he lived in Lima, Peru. Why he was there or what he was doing are not accurately known. Letters and other family records indicate that he had some work there with an engineering project, probably connected with the construction of a bridge or with some sort of mining venture. In January of 1869, a United States patent covering a centrifugal screw pump was issued jointly to Henson and to a John H. White of Lima, Peru.

There is little evidence that Henson's interest in aeronautics extended beyond the first few years of his residence in this country. Among his papers has been found a pamphlet by Solomon Andrews, dated July 22, 1848, proposing an Association of Inventors of Aerial Devices. Andrews was then experimenting with odd-shaped balloons at Perth Amboy, N. J. Whether or not the two were ever in communication is not known.

Both Stringfellow and Marriott are known to have been in America after Henson's arrival here. The former came with his son for a short visit in 1849. Marriott left England and settled in San Francisco, also in 1849. He became a successful banker and newspaper owner and later (1869) patented a flying machine of his own. He died in 1884. There is nothing to indicate, however, that Henson was ever in touch with his former colleagues. He may even possibly have remained ignorant of the model flight of 1848. It was little publicized until the appearance of the F. J. Stringfellow pamphlet of 1892.

Several footnotes and penciled comments are found in a copy of John Wise's book, *A System of Aeronautics, Comprehending Its Earliest Investigations, and Modern Practice and Art* (1850), presented to Henson by his friend and fellow inventor, Joseph Yates, probably in 1855 or 1856. Wise, discussing Henson's *Ariel*, says on page 87: ". . . it was seriously contemplated to build one after his model, with which to cross the Atlantic." Somewhat indignantly, Henson appended: "This was mere newspaper talk, I never thought of anything so absurd. I knew that the steam Engine had to be remodelled to make steam navigation practicable and I still farther remodelled steam Boilers and produced the lightest engine ever built which on a small scale was still insufficient the Engine only developed 1/4 the power of the steam altho it was operated with a cut off." On another page, Henson made certain corrections in the stated dimensions of the full-scale aerial steam carriage and added the following information regarding the engine: that it was "twenty H.P. consisting of two Cylinder 7″ diam. 14″ stroke. The pair of Engines and Boiler were actually built by Houchin of the City Road London. Richard Houchin was recommended by John Farey C.E. an eminent London Engineer and authority in Engineering. It was never tested." This is the only indication that construction work on the full-scale project was actually started before the transit company's collapse.

Although Henson spent at least 10 years on the subject, he was not essentially *aeronautically minded*. Considering the state of the art in the middle Nineteenth Century, one has no reason to expect that he would be. He did not have the scientific curiosity nor the educational background of a George Cayley. He was primarily a mechanic — an inventor. All his life he was continually thinking up new ideas in mechanics and in machinery. To him no mechanism was perfect. Each new device that he saw apparently challenged him to improve upon it. He would work intensively on something for a time, then drop it — a new razor, an aeroplane, a breech-loading cannon, a method for waterproofing fabrics, an ice machine, a springboard, or a device for cleaning cisterns. Toward the end of his life he became intensely interested in the mechanics of the universe. He observed, he read, he speculated, and he wrote on astronomical matters.

His only known published work is a treatise on astronomy privately printed in Newark in the spring of 1871. It is short, only 28 pages, but its scope can be gauged from the title: "The Great Facts of Modern Astronomy with an Exposition of What They Teach, Comprising the Formation of the Sun and Stars, the Cause of Rotary Motion, the Formation of the Planets and Their Satellites, Solution of the Law of Distances, Theory of Light, and the Sun Spots." Evidently Henson was not

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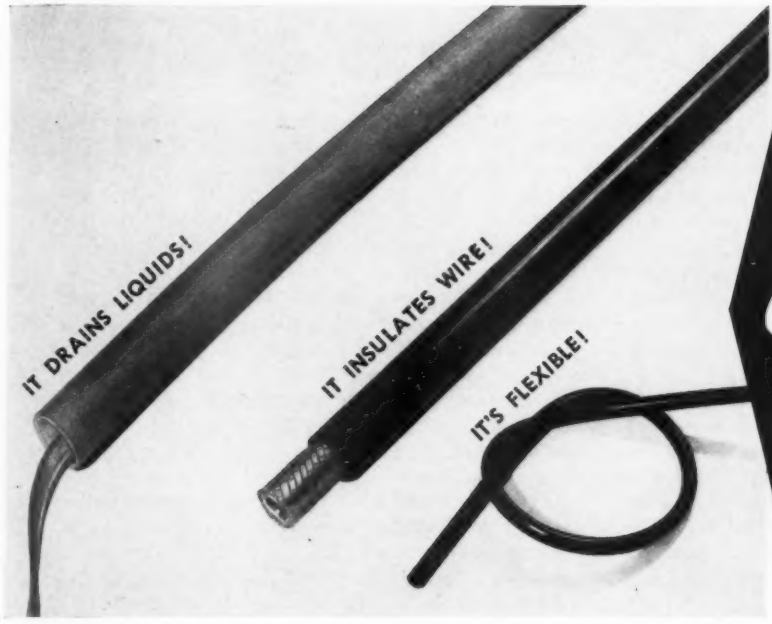

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EXTRUDED PLASTICS AND SPECIAL TOOLS

GRANDFATHER OF FLIGHT

(*Concluded from page 436*)

one to cramp his imaginings by limiting his subject. A few copies of this book still exist. There is no evidence that it had a wide circulation. The final paragraph of the preface yields a tenuous clue to the character of the man: "I make no pretentions to be an astronomer, or to enter into the extreme exactness of that exalted science, but the business of my life has made me familiar with mechanical motions; and believing that I have traced the motions of the planets to their source, I have undertaken in my own way, to make it known. If it is truth, as I believe it to be, it will stand; if it can be shown that it is not true, let it fall."

Henson called himself an engineer — "civil," "mechanical," or "consulting," as his situation seemed to warrant. Although he probably lacked a degree, he cannot be criticized for so styling himself. The engineers of the middle 1850's were practical men as well as theorists. They could do things with their hands. Thus, Henson qualifies. By all the standards of the times, he was entitled to write the word "engineer" after his name.

He came by his talents honestly. For at least two generations before him, his people had been mechanically inclined. His grandfather Thomas, "the strongest man in Nottinghamshire," was a cabinetmaker and wheelwright. Born in the town of Bunny, he married Anne Piccard and settled in Ruddington, where his son William was born on August 22, 1786. Young William probably had little formal education, but he was apprenticed at an early age to a "framework knitter" in Nottingham (probably about 1798). He married Martha Charge in 1807. His progress was rapid, for by 1812 (the year William Samuel was born) he was elected a burgess of Nottingham and was already talked of as an "inventive genius." He had survived the Luddite riots of 1811–1812 with some distinction. About 1820, he and his growing family moved to Worcester, where he became a manufacturer of lace, leaving a trail of patents for devices to improve the machinery and processes of manufacture. His first wife died sometime in the early 1830's, and shortly thereafter he married again and moved to Chard. Between 1845 and 1848 he moved to America and settled in Newark, where William Samuel joined him in 1848. According to the Nottingham *Guardian* of November 5, 1879, the senior Henson contrived a considerable improvement in carpet machinery, "of which he was thoroughly robbed by the Yankees . . . and sorely wounded by the gross rascality with which he was treated in America, he left that country. . . ." Subsequently, he lived to an advanced age, inventing things almost to the day of his death, October 17, 1879. He is buried in Nottingham.

Of William Samuel Henson as a person, only the sketchiest accounts remain. His surviving daughter, Mrs. George W. Lipsham, is now too ill to be questioned. The only other living relative who knew him is a grandson, E. T. Henson, who "saw . . . grandfather only once when, as a child of 10 or 11, I visited his home for a week or two. I recall him as a gray-bearded, pleasant enough old gentleman who had a kindly interest in one of his grandsons and was kindly and gracious." (This visit must have occurred shortly before Henson's death.)

Family tradition has it that as an old man, he was inclined to be dictatorial and of strong opinions, especially where politics was concerned. Like many inventors, he was a poor businessman. He had ideas — others profited by them. When he had a little money, it would dribble through his fingers, and he would think up something new to try to recoup his losses.

Henson was certainly not one of the great men of history. He made little lasting contribution to science or to engineering. Unlike the name of Watt or Stephenson or Fulton, Henson's name is not associated with the beginning of a new era. He was one who let his imagination roam in regions that could not be explored and exploited until the more solid workers — the plodders, if you will — had contrived the tools to cut the steps on which to climb. Such will-o'-the-wisps of science serve a useful purpose. They dart hither and yon, enticing others to venture after them. Some of their followers stumble into pitfalls and vanish. Others find solid footing and win to some lasting achievement.

THE DILEMMA OF SYMPATHY

(*Continued from page 428*)

Fatigue of Workers, issued by the National Research Council's committee on work in industry: ". . . the increase in the output rate of the girls in the Relay Assembly Test Room could not be related to any change in their physical conditions of work, whether experimentally induced or not. It could, however, be related to what can only be spoken of as the development of an organized social group in a peculiar and effective relation with its supervisors."

In trying to find out what actually went on in the workers' minds, what they liked or didn't like about the company, why they didn't work with their fullest co-operation, the investigators at the Hawthorne plant interviewed over 21,000 individual employees between 1928 and 1930, and as experience with this program piled up, the interviews took on more and more of a psychoanalytical flavor. Shades of Frederick W. Taylor! Very little attempt was made to steer the conversation into channels with a direct interest to the management, the attitude being that if a worker kept returning to the same theme again and again, that topic revealed important information about him, regardless of its lack of objectivity or direction. Though such an elaborate peering into the worker's mental state is not yet common in industry — it is time consuming, requires a skilled staff, and, if not handled with the greatest discretion, may easily arouse suspicion — surveys of attitudes by means of questionnaires are becoming increasingly common. Just as sociological and psychological techniques are being applied to the human problems of industry, so are the methods of sampling mass opinion which have been developed by students of political questions and business markets. An article on the organizational problems of an instrument manufac-

(*Continued on page 440*)

A

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Our Personnel Office is open from 8 to 12 a. m. and 1 to 5 p. m. Monday through Friday and on Saturday mornings. We shall be glad to have you or any member of your family come in and see Mr. Tribble, our Personnel Director. If you prefer to telephone in advance, our telephone number is 3-5258.

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THE DILEMMA OF SYMPATHY

(*Continued from page 438*)

turing company recently appeared in the journal *Applied Anthropology*. After all, why are the relationships and frictions of a group of engineers any less a subject for anthropological research than is the social life of a group of Fiji Islanders?

Just a few months ago an Associated Press dispatch told how the Army is using questionnaires to "track down rumors of complaints about various phases of Army life and find out what is wrong, if anything." The questioning is done with ballot-box anonymity, an important condition in making such surveys a success, and 98 per cent of the answers seem to be honest expressions of opinion. Among the more interesting facts revealed by some recent surveys of employee attitudes in industry is that between 20 and 40 per cent of the younger workers feel that they are not getting the advancement they deserve.

Perhaps the most important problem uncovered by these various new approaches to the study of worker fatigue and labor relations is defined by a brilliant phrase from *Fatigue of Workers*. The investigators speak of a "failure of communication" among the various levels of the organization. Particularly in large and elaborate organizations, no adequate channels exist by which the management can be informed by the workers of their fears and aspirations and of the many other considerations which may disturb them. Nor does the management commonly take the trouble to convince the workers that the changes which it is continuously initiating and which often require painful adjustments on the part of the men at the work levels are for their mutual benefit.

To change a man's duties, to move him from one point to another in the plant, to promote or demote him, or to change even the size and construction of his desk is to interfere with the complex, subtle, and hard-to-learn fabric of social relationships, feelings, and loyalties which begins to form whenever a group of people work together for any period of time. To use Roethlisberger's shrewd illustration of how complicated these relationships may be, a person talking with his boss acts differently when the boss's boss is also present. And if he doesn't react to delicate differences in situations, he doesn't get along well with people. Indeed, the man who ignores the entirely unofficial sanctions of the group and who does not automatically examine every change in it with an eye to its possible effects on his standing and prestige is so rare that he is apt to be suspected of having some psychic abnormality. This social fabric rather than the formal organization of industry determines behavior and forms the basis of discipline and co-operation.

But here a dilemma begins to emerge. Since the demands of the formal organization of industry and the quite informal social fabric which also relates the personnel are in conflict at many points, which shall prevail? There is little question that, as the anthropologist Ralph Linton put it: "It is clear that the individual

(*Continued on page 442*)

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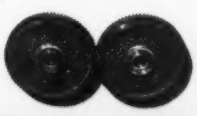

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THE DILEMMA OF SYMPATHY

(*Continued from page 440*)

has psychological and emotional needs as well as physiological ones and that part of the culture is to provide satisfaction for these. . . ." As far as the individual's physiological needs are concerned, industry to a large extent already recognizes that it must meet them, and progress in that direction has been helped in no small measure by the fact that precautions for the health, safety, and comfort of its personnel almost invariably pay in the long run. But if industry is to make any substantial attempt to establish an ideal environment for social man (in so far as we understand what such an environment includes), management must abandon many of its traditional methods and aims.

While some workers can be found who seem to prefer the conditions of mass production and the production line above all others, the monotony arising from that source is one of the important causes of fatigue and discontent in industry. Should we then discard these techniques? Changes in social patterns must normally take place extremely slowly if painful adjustments are to be minimized. As Elton Mayo points out in his introduction to Roethlisberger's book, "In a simple society the extent of change from year to year, or even from century to century may be relatively small. Traditional methods are therefore brought to a high degree of perfection; almost from birth disciplined collaboration is drilled into the individual." By way of contrast, he cites the fate of the chief operators of the tin-plate mills of western Pennsylvania a generation ago. Highly skilled men, they had considerable prestige in the mills and in their communities. But processes changed; as a result: "In these days the skill they possess has been completely superseded, their social position by consequence abolished." One can list a few revolutions which have also abolished social positions, and wholesale. Would we be better off today had there been no such revolutions? Is there not a moral in the fact that India, symbol of rigid, unchanging social structure, is the largest reservoir of silver in the world? Why? Because its people have deep-seated traditions about keeping their wealth in concentrated, easily portable form — an excellent precaution for those who are frequently exposed to physical insecurity.

As previously mentioned, the ceaseless flow of orders from the management down to the work levels, disrupting habits, changing rates and methods of payment, punishing slackness and inefficiency, all disturb the worker's peace of mind. Even in the Soviet Union, which avows a philosophy of government whereby the proletariat rules, which actually started by giving the workers a large voice in the control of industry, management has gradually re-exerted its authority until today it appears that the Russian worker is under as strict a discipline as exists in any capitalistic country. With few exceptions, each Russian worker or salaried person must have a "labor book" which enables the authorities to check effectively on his movements and rates of payment, while unaccounted-for lateness and absenteeism have long been punishable offenses. An interesting parallel may be found in the tightening up of discipline in the Red army and the increase in the authority of officers which followed the Russo-Finnish War. In Mexico, President Camacho recently had occasion to point out to the Workers Syndicate some of the by-products of Mexico's attempts to free its masses from abuses and exploitation by moving toward a worker's Utopia, free of hard-eyed bosses. In accusing labor of being principally responsible for the chaotic state of the government-owned railroads, he mentioned the workers' "lack of discipline, inexplicable waste of material and useless and unnecessary misuse of materials," and the "impossibility of obtaining efficiency and responsibility from the railroad workers." To crown it all, at least one union in the United States, the giant International Ladies' Garment Workers union, has declared that since inefficient management in its industry has an unfavorable effect on the earnings of workers on piece rates, such inefficiency is therefore a legitimate condition for union action. Furthermore, a detailed clause to that effect has been inserted into an agreement which the dress manufacturers of New York, after some bickering, signed.

As always, the primary burden of making a satisfactory adjustment to his environment must still remain with the individual. Management, like labor, has its crosses to carry, and many a worker would be surprised to learn how much executives must bear and forbear in the ordinary course of their duties. Labor in general, for example, cannot expect supervision so intelligent or so considerate as that experienced by the girls in the relay test room at the Hawthorne plant. There just isn't enough supervision of that caliber to be spread so thick. Labor cannot expect industry to alter its techniques or its methods of administration beyond the point where a net gain to industry, or at least to the community, results, for the primary purpose of industry is to produce efficiently, not to form a pleasant place in which to work. The struggle for existence continues as fiercely as ever it did, except that the contest is now primarily between nation and nation rather than between man and man or man and nature. If monotony, uncertainty, and physical strain are the price of progress for industry, the price must be paid or a far heavier price will some day be exacted in toil and blood. It is our particular era's brand of hard luck, just as glaciers were the cave man's.

Yet much can be done which, far from interfering with the technical functions of industry, might actually make them move more smoothly. Harmony and larger profits would probably result if greater use were made of intelligence, aptitude, and personality tests even in their present state of development, and if more attention were given to individual preferences and ambitions in placing workers, so that cases of poor placement would be rare enough to deserve to be called accidents. Some of the sting of technical change would be removed if industry established large-scale, continuous, and well-planned educational programs not only to train newcomers but also to keep the older workers abreast of their arts. The ability of people to learn as they grow older seems to be quite generally underrated for, according to some investigators, adults — at least

(*Concluded on page 444*)

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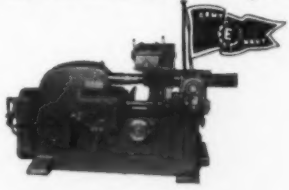

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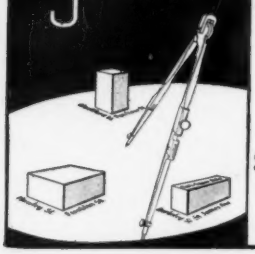

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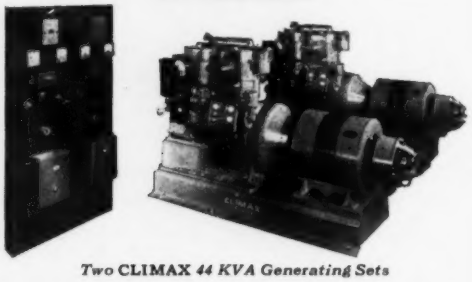

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THE DILEMMA OF SYMPATHY

(*Concluded from page 442*)

until the age of 45 — will learn about as readily as when they were adolescents, particularly if the material is in line with previously established interests. In the conversion of American industry to war, whole factories of employees have been trained, and successfully, to wholly new trades. And, obviously, there is no excuse for such lack of personal consideration on the part of a management that a majority of its workers will declare, as they did in one survey, that the owners "do not treat the workingman like a human being."

As Uncle Dudley said some time ago in the Boston *Globe:* "To release every form of talent is one main function of human society." History has a few cases of nations and periods in which men worked together with trust and enthusiasm. We can have no nobler aim than to create such a state in our own time.

DR. GATLING AND HIS GUN

(*Continued from page 426*)

The Indianapolis inventor also managed to get the sympathetic ear of the Navy. That department had just registered one conspicuous success through making experiments, even against the resistance of an old-fogy bureaucracy. Secretary Gideon Welles had as little patience for traditionalists as for fools. Gustavus Vasa Fox, an able career naval officer, had become "Father Gideon's" Assistant Secretary, supplying much of the technical and professional imagination and policy for a Navy direction that got amazing results. Over the old-timers' protests, Welles and Fox had both pushed to get John Ericsson a contract to build the *Monitor;* the contest with the *Merrimac* in Hampton Roads had shown the great value of the "cheesebox on a raft." Now the Navy ordered a few of Gatling's new quick-firers, on the chance that they might be good to repel boarders or perhaps to cover landing parties from cutters. The result was that Gatling's trip to the embattled capital on the Potomac was not a complete water haul.

Interestingly enough, the first actual employment of the Gatling gun was not in troop action but in the New York draft riots of July, 1863. These had been preceded by ominous threats of hoodlum elements against the chief pro-Union papers, Horace Greeley's *Tribune* and

(*Continued on page 446*)

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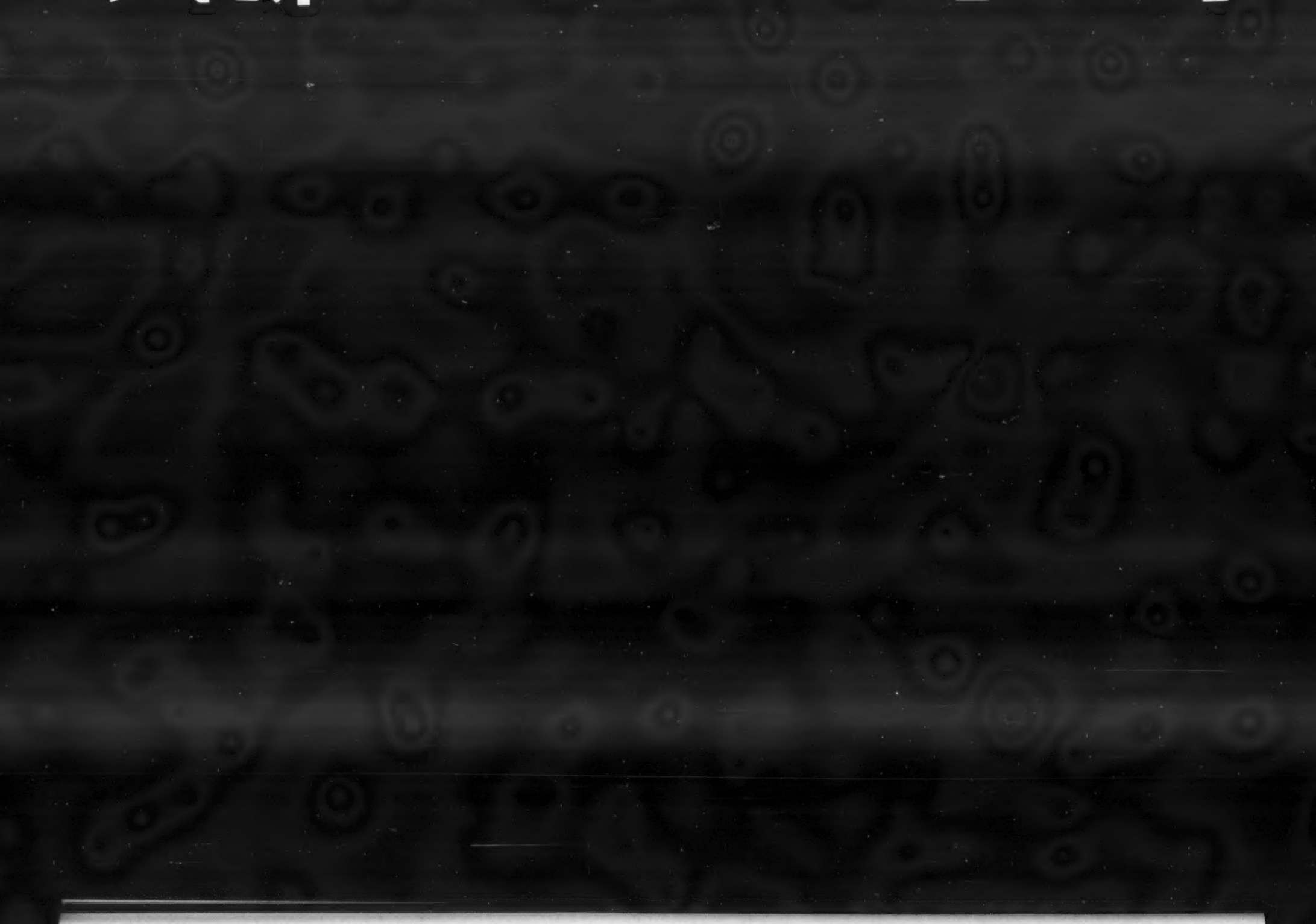

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DR. GATLING AND HIS GUN

(*Continued from page 444*)

Henry J. Raymond's *Times*. Raymond, later to be congressman as well as newspaper proprietor, ordered that the quarters of the *Times* be prepared for efficient defense against any mob that might come against it. A tradition of the paper, as cited by Elmer Davis in his history of the *Times*, was that Raymond's close friendship for President Lincoln led him to apply to the latter for some Gatling guns and that Lincoln obligingly had three of them dispatched to Manhattan. Be this as it may, the guns were procured. One was mounted on the roof, so that its field of fire could sweep the street in either direction; the other two were set up inside the business office; and the entire staff was issued rifles. Any rioters attempting entry into the plant would have had a hot reception. On July 14, 1863, a mob did break into the *Tribune* offices and caused considerable damage. But the *Times* building was not invaded, and the Gatling guns were not put to the practical test.

An interesting side light on this emplacement of the doctor's invention to combat fifth columnists is that from late 1862 onward, Gatling himself was under suspicion as a subversionist. What motives originally led him to join the Knights of the Golden Circle, a sophomoric secret order which swept the Border States in 1861–1862, have never been clearly disclosed. Doubtless his North Carolinian birth and boyhood had much to do with it, as did the further fact that Indiana democracy was a hotbed of the new order which masked treason in ritualistic mummery. To these must have been added Dr. Gatling's resentment over the cavalier treatment he received from the Ordnance Department.

Whatever the cause, the fact was clear that the inventor drew closer and closer to the Confederates. Records of the judge advocate general's office and the letter books of the Secretary of War, now in the National Archives at Washington, give some clues to the inventor's course. When the Knights of the Golden Circle was exposed and its ringleaders were arrested early in 1862, a second organization — the Order of American Knights — was soon established. Gatling became a leader in O.A.K. councils in Indianapolis, as spies within the lodge soon told the Federal authorities.

This new order proved about as inept as had the Knights of the Golden Circle. Late in 1863, its national leaders in Missouri were arrested, and its effectiveness was virtually ended. The chief Copperheads, however, soon rigged up another society for treason, this one called "Sons of Liberty." Again Dr. Gatling took an active part in its Indiana council.

The Federal authorities smuggled their own spies inside the Kentucky and the Indiana state councils of the new order, and they reported some quite alarming activities. Felix G. Stidger, the most successful of them, soon informed Colonel Edward C. Carrington, the Army's provost marshal for Indiana, concerning details of Dr. Gatling's participation. Stidger reported one meeting in Louisville at which the Indianapolis inventor had proposed a sort of Greek-fire filling for bombs either for Sons of Liberty troops or for their Confederate allies.

(*Continued on page 448*)

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DR. GATLING AND HIS GUN

(Continued from page 446)

There was talk, too, that the designs of the Gatling gun might be turned over to the Confederate Army, inasmuch as the United States Army had rejected it.

These Stidger reports, and others, led Carrington to try to lay the basis for haling Gatling before a military commission to put him on trial as a dangerous conspirator against the United States. The particular charge, probably, would have been that he had sold his machine gun to the United States Army but now had betrayed it to the enemy.

Carrington's efforts to establish any basis for this were frustrated by the War Department in Washington. On July 13, 1864 — almost a year to a day after the New York riots in which three of the guns had been mounted to protect the *Times* office — Colonel James A. Hardie, inspector general in the Office of the Secretary of War, answered Carrington's inquiry: "I am directed to inform you that the Ordnance Department have never purchased any of the 'Gatling guns' and that only very few are in use in our Navy. The gun does not enjoy a high reputation."

Despite this categorical denial that the Federal Army bought any of the new guns, Dr. Gatling's own elaborate diaries and reminiscences contend that they did play their part in the campaign outcome — in particular, in one small sector in the Petersburg campaign in March, 1865. The records do not reveal the way the gun got to the Army. But there is report to the effect that, when used, "its devastating fire struck consternation" to the enemy directly in its path.

Apparently Gatling had given up immediate hope of crashing the gate of the Ordnance Department. Late in 1862, after General Ripley had pushed him aside, he turned to foreign fields and in particular to Emperor Napoleon III of France. In 1863, Gatling crossed the Atlantic and demonstrated his gun to the French experts, who eagerly borrowed its fundamental ideas. The Montigny mitrailleuse, which the French brought out shortly thereafter, was chiefly an adaptation of the Gatling gun. When the latest model of the gun was shown at the Paris exhibition in 1867, the Empress Eugénie herself once turned the crank to run the gun. Gatling termed Louis Napoleon "a shrewd little chap" and was pleased at the attention paid him and his gun.

There is an ironic postscript to the United States Army Ordnance Department's record. Gatling kept working on his gun, and on May 9, 1865, the Patent Office issued him a second patent, No. 47,631. He termed this one "Battery Gun," and described it thus: "This gun belongs to the class of many-barrelled field pieces and consists of a series of barrels mounted on a central shaft or spindle and revolved by suitable wheel gear and hand crank. The charges or cartridges are automatically fed into the chambers of the barrels successively, and the several hammers are so arranged in connection with the barrels, that the whole operation of loading, closing the breech, discharging and expelling the empty cartridge cases, is conducted while the barrels are kept in a continuous revolving movement."

(Concluded on page 450)

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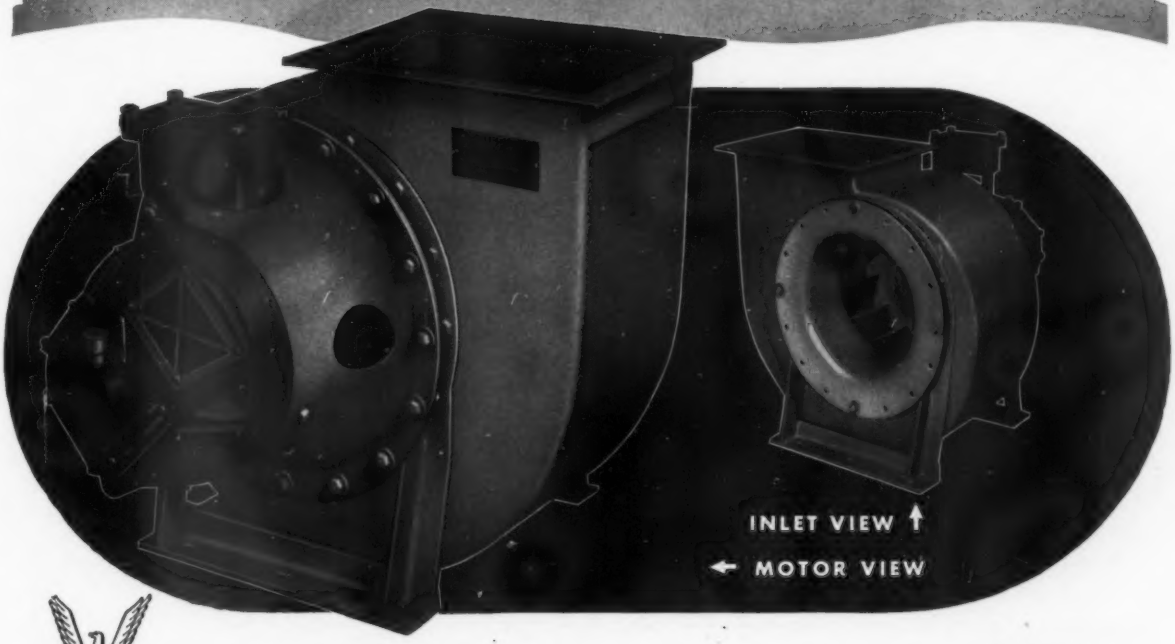

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DR. GATLING AND HIS GUN

(*Concluded from page 448*)

About this time the Ordnance Department began to take a new interest in the gun. The Civil War was over, Lee had surrendered — and there was a new chief of ordnance. General Ripley had been replaced by Brigadier General Alexander B. Dyer, a younger and abler man. Gatling's gun was now given a trial. Secretary of War Edwin M. Stanton and his chief of ordnance had models tried out, with field firings at Washington, at the Frankford Arsenal in Philadelphia, and at Fortress Monroe. These trials showed that the gun would work. Its rate of fire had been built up to about 1,200 rounds a minute. In 1866 the Army ordered 100 Gatling guns, and thereafter it was standard equipment for the Army until later inventions replaced it.

By that time, however, Dr. Gatling had found more fertile fields for sale than the military services of his native country. He licensed the British ordnance firm of Sir W. G. Armstrong and Company to manufacture his invention, and for decades the company's great munitions plant at Newcastle upon Tyne turned out these weapons for shipment to Russia and China, Argentina and Chile. Gatling visited St. Petersburg, where Alexander II, Autocrat of All the Russias, entertained him at the Winter Palace and personally conducted the doctor about the palace to display to him the crown jewels, the great paintings, and the other treasures. No wonder the visitor described the Czar as "a plain, unassuming gentleman."

Gatling's gun made him immensely rich — at least, as wealth was measured in America in those days. In 1870 he sold the American rights to Colt's armory at Hartford, Conn., which manufactured the guns for American sale and competed with Armstrong's for the markets of the world. The foreign military men realized that each army had to buy this modern arm to counterbalance the danger of use of it by the potential enemy. That same year the inventor moved to Hartford.

Despite his sale of the basic patents, Gatling's zeal for improvements on his weapon continued. On February 28, 1871, he was issued Patent No. 112,138 on a new model, and on April 9, 1872, a further one, No. 125,563. For the next two decades his inventive interest was focused on other types of devices, principally agricultural machinery. But in the early Nineties he returned to the machine-gun development competition, perhaps because of the Hotchkiss and other upstarts. During 1893 he was issued three machine-gun patents, the last one on September 12, No. 504,831.

Thereupon he reverted once more to his boyhood zeal for new farm machinery. When he was 80 years old, he established a company in St. Louis to make a steam plow and other farm machinery. For six years he was president of the American Association of Inventors and Manufacturers. He died in 1903 at the ripe age of 84. His "humanitarian invention" lived after him, however, and its basic principle is employed by many armies in today's total war. The first syllable of his name is preserved in gangster argot, for "gat" came from the Gatling gun.

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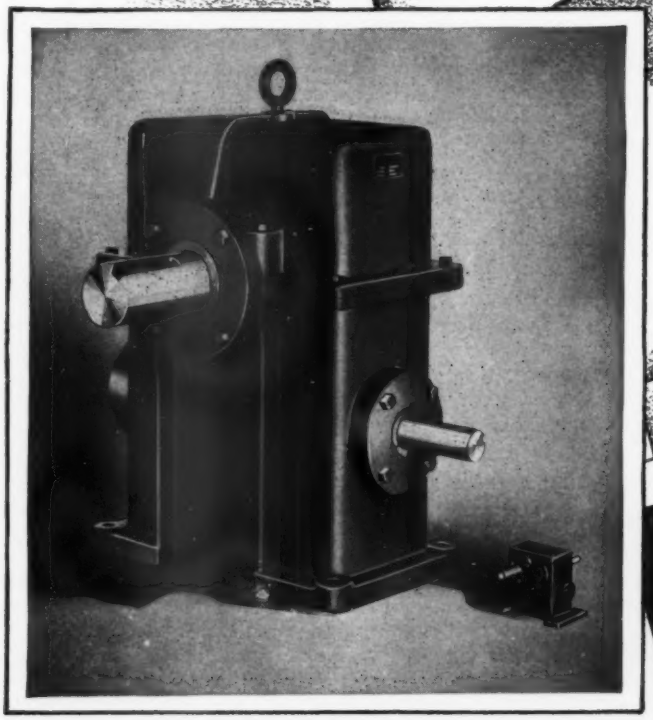

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TECHNICAL FORCE: ECONOMIC STRESS

(*Continued from page 424*)

functions of the price system is to determine the quantity of the different kinds of goods which will be produced and consumed throughout the economy. This function cannot be performed efficiently if various prices are deliberately held above the level of cost.

Briefly stated, the economic effect of a technological innovation on the domestic economy is to alter the optimum allocation of workers, materials, plants, and other productive agencies. If we are to insure that these various resources make their maximum contribution to the general well-being, we must see that they are redistributed according to the requirements of each new technological situation. We must have our labor and our capital goods in the places where they are most needed as indicated by cost and price relationships. If we plan to retain the private-enterprise method of controlling economic activities, we must live up to the rules of the game and follow the guides of the price system. No attempt will be made here to discuss ways and means of enhancing the adaptability of the economy. The first prerequisite of improvement is to recognize the essential nature of the problem. When in the aftermath of war the rate of technological change is accelerated, this recognition may be of great assistance in enabling us to arrive at a correct solution.

SINCE commodities move across national frontiers in accordance with cost and price differentials, conditions affecting costs and prices determine the economic position of a nation in the world economy. Natural and human resources are, of course, basic factors in international trade. Yet the effectiveness with which the labor of a nation is utilized in converting materials into finished goods depends in large measure upon technical knowledge, skill, and equipment. And technology has another and even greater significance: By determining what materials shall be used and what kinds of labor shall be employed, technical conditions have an important influence in deciding which regions will be selected to specialize in the various branches of production. Countries with a relative abundance of the appropriate resources are chosen; those with relatively little are rejected. Thus the international exchange of goods and hence the position of each nation in the economic system of the world are to a large degree decided in our scientific and engineering laboratories, though of course one should not underrate the importance of politics, education, law, and the other components of the institutional framework in which economic and technological factors operate.

Likewise, it may be said that changes in technology deflect the channels of world trade and alter international relationships. The development of the sailing ship and of new instruments for navigation transformed the ocean from a barrier into a communicating way and laid the foundation for the commercial predominance of the nations of western Europe. When steam was applied to transportation, bringing the farmers of our Middle West into competition with grain producers on the other side of the Atlantic, a serious depression in European agriculture followed. Examples might be multiplied from the history of our own times. The discovery of new techniques, such as the atmospheric fixation of nitrogen and the process of selective flotation, the invention of substitutes for such things as camphor and indigo, have had important international repercussions, as is well known. We are now speculating as to the ultimate effect upon the foreign trade of Scandinavia and Canada of the devising of more efficient means for utilizing southern pine in the manufacture of paper, and we are wondering what is going to happen to the postwar exports of Japan, Java, and the Malay States as the result of the development of synthetic substitutes for silk and rubber.

There is no doubt that the coming flood of technological innovation will create serious economic problems for the postwar world. Suppose, for instance, that Japan should lose a substantial part of its foreign market for silk and therefore lose also the power to buy foreign goods, which those exports furnished to the Japanese people. The international position of Japan would be different from what it was before the war. The nation would be compelled to find new exports that would take the place of silk, or to curtail its imports. Either of these readjustments would affect other countries: If new exports were developed, the industries of other nations would meet increased competition from Japanese producers; if imports were reduced, the industries of other countries would be deprived of an important foreign outlet. The loss of purchasing power resulting from the invention of substitutes for silk might be made up by Japanese borrowings from abroad, but this would be only a makeshift, a temporary means of postponing the inevitable. Eventually foreign trade would have to be reorganized — not only the trade of Japan but also that of the United States, Great Britain, China, India, and other countries with which Japan has developed commercial relations.

Let us not deceive ourselves. World trade, in such circumstances, must be reorganized, and the process is bound to be harmful to certain vested interests. The choice before us is whether to promote readjustments that carry with them an increase of trade or those that result in reducing the range and volume of it. Specialization involves exchange of goods. If we choose a policy of expansion, we shall foster national specialization and therefore stimulate world production: if we choose a policy of restriction, we shall divert resources to uneconomic uses and fall short of achieving the largest possible output of goods and services.

After the first World War, the nations decided almost unanimously in favor of restriction. Countries whose purchases of foreign goods should have been allowed to increase so as to prevent a contraction of trade, imposed barriers of various kinds — tariffs, quota limitations, currency depreciation, and exchange controls. These barriers forced other nations — those whose international position required increased sales of goods abroad — to adopt the alternative of curtailing imports. Thus one set of restrictions called forth others;

(*Concluded on page 454*)

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TECHNICAL FORCE: ECONOMIC STRESS

(*Concluded from page 452*)

and as the restrictions multiplied, the disequilibriums increased and spread. Between 1929 and 1932, the physical quantity of world trade decreased by more than 25 per cent, a decline which was accompanied by a collapse of prices. The gold value of international trade by 1932 had fallen 60 per cent and its sterling value 46 per cent, as compared with what they had been in 1929.

From the end of World War I to 1929, the trade of the world was supported largely by credit transactions. The gaps in the international accounts of various nations — gaps which had been created by wartime technological and other changes — were filled by the movement of capital. Such movements perform a very useful function. The commercial adjustments necessary to equalize payments cannot be made at a moment's notice. A nation cannot make great changes in its foreign trade without undergoing slow and painful internal industrial transformations. And it may be said that if disorder is to be avoided after the present war, provision must be made for international borrowing and lending on a large scale. Yet transactions of this sort, however necessary they may be to cushion the shock of change and to ease the transition, cannot be regarded as offering a long-term solution of the problem. This statement is supported by our own experience: During the 1920's, when foreigners urgently needed American dollars to meet their payments to us, we advanced them the money through the purchase of foreign bonds. This policy would perhaps have been justified if at the same time we had prepared the way for the eventual substitution of imports for loans. We made no such preparation. On the contrary, we raised the barriers against foreign goods. Our loan policy, as might be expected, broke down. The more bonds we bought, the greater the interest obligations of the debtor countries became; as these obligations piled up, our international financial position became more and more unbalanced. When in 1929 we finally curtailed our foreign loans, the debtor countries were compelled to adopt drastic import restrictions.

This experience is not mentioned to suggest that the United States was the sole offender. But it does show what the result is likely to be at the end of World War II if each nation undertakes to regulate its foreign trade without regard to the broader implications of its policy. There is today much sentiment in favor of international co-operation. We need to realize, however, that co-operation is a practical necessity. Technological as well as other types of innovation, by changing the factors which determine the localization of production, will call for some redistribution of industry among the nations of the world. To soften the impact of these changes and to facilitate the necessary long-term readjustments, hard economic and political thinking will be required, as well as a willingness to co-operate in working out concerted policies. The way of isolation leads to international economic chaos.

To say that the domestic economy should be freed from the restraints of monopoly and that the world economy should be freed from the restrictions of autarchy is not to advocate a domestic policy of *laissez faire* or an international policy of unmitigated free trade. In the domestic economy, intervention is necessary not only to curb monopolists but also to promote the adaptations required by changed technological conditions. A good example of the latter appears in the report Sir William Beveridge recently submitted to the British Parliament, in which he proposes, as one of several measures for social security, that training benefits be made available to assist in re-educating those who are thrown out of work on account of technological innovations.

Constructive intervention will be necessary also in the world economy. No nation can afford to abandon its producers to the operation of crude international competition: its industries will need guidance and help during the painful transitions resulting from technical discoveries. Most important of all, a social framework must be constructed which is favorable to the extension of international division of labor. Perhaps no argument for self-sufficiency is stronger than that of military necessity: the nation must be freed from economic dependence in time of war. The United States, for example, acting on this principle, may be extremely reluctant to curtail its synthetic rubber industry after the war even if sound economic reasons are adduced for doing so. Unfortunately this policy of national self-sufficiency is itself a potent cause of international dissension, for if the different nations proceed to block their neighbors from important materials and markets, the grievances of the have-nots and of the overpopulated nations become causes of bitterness and aggression. Thus the fear of war breeds war — an intolerable chain of events involving endless struggle and destruction.

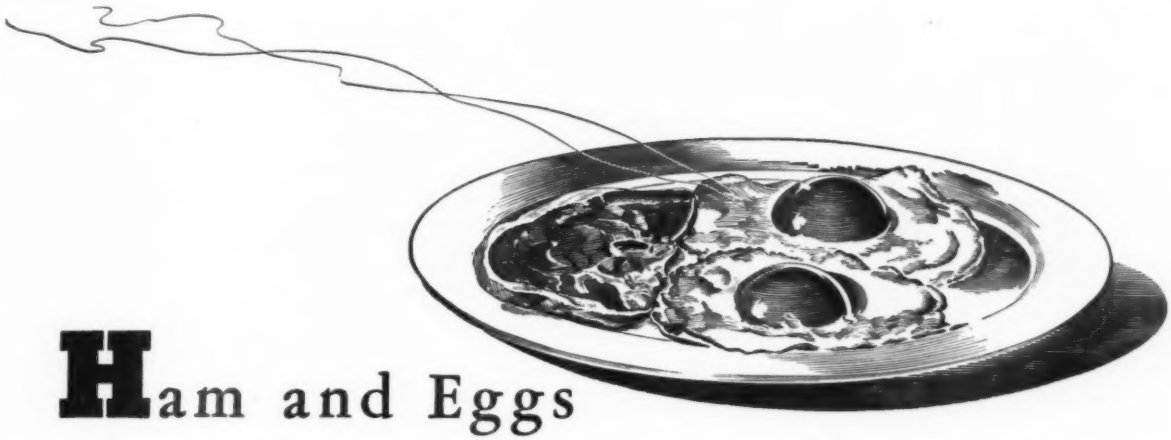
THE TREND OF AFFAIRS

(*Continued from page 418*)

advantage in wartime. Sawdust concrete is being tested in several American universities. Concrete is bound to play an important role in low-cost housing, and architects have advanced novel plans calling for use of it. One interesting approach is that of Tom Hibben at the experimental housing project at Arlington, Va. Applying new technique to an ancient method, he has built livable three-room bungalows out of plain mud with a little cement or emulsified asphalt to bind it. The earth houses may be built of earth-cement blocks, or molds for entire walls may be made and the mixture rammed into them. After treatment with cement paint, the houses are trim, attractive, and economical to heat. Experiments at the University of Illinois show that almost any kind of dirt can be used; the secret is to analyze the soil and write the recipe accordingly.

But the really big success of ordinary dirt stabilized with cement is in roads, streets, and airfields. To highway and military engineers "soil cement" has become a

(*Continued on page 456*)



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THE TREND OF AFFAIRS

(Continued from page 454)

magic word, signifying invaluable speed and economy. Soil-cement paving got under way in the middle 1930's as an inexpensive way of surfacing roads and streets where traffic did not justify reinforced concrete. A mile of this paving might cost $4,000, while a mile of standard highway concrete would run to $30,000 or more. Many states have used soil cement on secondary roads; cities like Lowell, Mass., and Columbia, S. C., paved streets with it, and when Pearl Harbor found America in need of some 4,000 more airfields, the new process went to town in double time, for both continental and offshore bases.

As a means for creating short-order airports on almost any soil, this method has no equal. The process is simple: After the ground is broken by scarifiers and pulverized with disk harrows, dry cement is spread and harrowed in thoroughly. Water — carefully measured — is sprinkled over the mixture. After more harrowing to dampen the mixture evenly, the field is rolled to a firm smooth surface, which is good, engineers say, for more than ten years' service.

In one rush job, men and machines set to work on desert land and after 18 working hours, had paved more than seven acres. One entire airport of 750,000 square yards was completed in 42 working days. And there are other savings. Since surface soil forms about 90 per cent of the mixture, trucks, tires, gasoline, and shipping space are conserved. Army engineers are being trained to use soil cement for emergency construction and for repair of bombed airports. By keeping on hand a supply of dry soil premixed with cement, airfield maintenance men can now repair shell craters almost before the drone of enemy bombers has died away.

Breaking away from the traditional gray, concrete is now being made in every color of the rainbow. Concrete camouflage dyes are made to conceal war plants from the air. Prepared in powder form, dissolved, and added to the mix, the colors simulate surrounding foliage or earth. Other dyes are being used for concrete floors and offer attractive possibilities for houses. Bomber plants have used white concrete to pave their floors, with the result that light softly reflected on the undersides of plane wings gives better illumination for workers. Black concrete, made by addition of carbon black or iron oxide, has been used in a number of highways to cut the

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glare of night driving; in Texas, permanent strips of black concrete now take the place of the painted white center stripe which had to be renewed every six months.

An M for a T

MORE than five million tons of metal will be made available for war service during this year by the substitution of wood in the manufacture of products previously made of metal, according to estimates based on reports of the War Production Board, the Army, the Navy, the Maritime Commission, the Forest Service, the Census Bureau, and industrial concerns. The amount of metal "saved" as a result of this conversion is of the same order as the figure for 1942. But in that year the utilization of wood instead of metal was primarily in the field of construction; in the present year the virtual completion of major construction programs has seen the metal-saving resort to wood shift into the field of production, where wood is taking the place of metal in a host of civilian consumer goods, the manufacture of many of which in metal has been stopped.

What the shift from metal to wood means statistically can be summarized in the fact that during the chiefly constructional phase of the development, the use of timber-connector construction is reckoned as having saved 400,000 tons of structural steel in roof trusses alone. Statisticians of the National Lumber Manufacturers Association have set up another yardstick in the finding that on the average one ton of steel can be saved by the use of 1,000 board feet of lumber. With cast iron, the saving can be greater; with sheet metal, it is smaller.

To Industrial Plant Owners

On page 439 of this issue of The Technology Review is an advertisement, paid for by us, which we commend to your attention.

We are running this ad because we believe in it; because we think it will help to meet a situation that is developing faster than you may think.

> **Brigadier General Alden H. Waitt, speaking recently at the presentation of the Army-Navy E award to the Standard Oil Development Company and its Esso laboratories, stated: "The casualty lists are mounting. By spring these lists will appall us and we shall begin to realize how serious the war has become. Then the entire nation will be ready to go all out for victory and right then we shall start to win the war."**

Therefore we pass the idea along to you and invite you to use it also . . . in the public print . . . for the public good.

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MAIL RETURNS

(*Concluded from page 410*)

In September, 1905, Manly had severed his connection with the Smithsonian and was in New York, engaged in the establishment of the Manly Drive Company. During those days, George D. McDonald was his shop foreman and principal assistant. Regarding the Dayton visit McDonald wrote to Basil Manly on October 27, 1940: "As for Mr. Manly's being in Dayton, Ohio on the 23rd of September 1905, it seems to me that it was almost impossible for him to have been there and for me not to have known anything about it as I was always demonstrating the machine while Mr. Manly did all the talking. If Mr. Manly was in Dayton, I am positive that he would have made himself known to the Wright brothers as he always said the Wright brothers were doing noble work." Incidentally, Mr. McDonald also stated positively that Charles Manly was wearing a large mustache at that time and for many years later.

Further, the records of the Smithsonian have been checked to see if any report was ever made to Langley or if any expense vouchers covering the trip were ever turned in. Manly's own letter files have also been investigated. None gives any intimation of the alleged trip. The matter of expense is pertinent because the correspondence shows that Charles Manly was then extremely hard pressed for funds and was borrowing money from a cousin, Professor William G. Manly, to meet the pay rolls and organization expenses of the Manly Drive Company. It seems quite improbable that he would have spent money at that time for a trip to Dayton simply to satisfy his curiosity — and there is no other reason in evidence to account for the trip.

Finally, the point has been made that the Wrights could not understand how Manly knew so much about their activities by November of 1905 unless he had actually been to Dayton. They were unable to explain otherwise the fact that accurate reports of their flying had been given to Alexander Graham Bell in Washington.

There is a simple explanation. Carl Dienstbach, a well-known aeronautical writer of the time, was in correspondence with the Wrights almost from the Kitty Hawk days. From 1903 through 1905 he wrote a number of articles for American as well as for German and other foreign papers, describing accurately and in detail the progress of the flying at Dayton. (A long list of references can be found in Paul Brockett's Bibliography of Aeronautics for 1910.) During the fall of 1905, Dienstbach wrote to Albert Zahm at Washington, giving him the latest information. During that period, Alexander Graham Bell held weekly soirees in his Washington home. There scientific matters of all kinds were discussed, none more actively than the newest of them all — aeronautics. To this group Zahm relayed Dienstbach's information. Later, Manly met with Zahm and Bell in New York and undoubtedly picked up from them the information that he included in his address to the Aero Club.

Altogether, I find no evidence whatever that the Dayton visitor was Charles Manly, nor can I find any logical reason why he might have gone to Dayton incognito as described. I can only repeat my original conclusion that "whoever the visitor . . . it was not Charles Manly."

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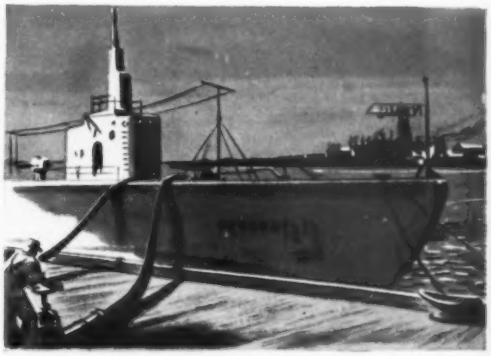
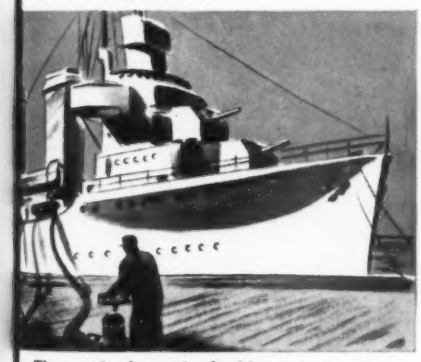
The entire mechanical rubber industry is applying its collective ingenuity, experience and skill from laboratory to shipping platform with results which, at times, may look like miracles to anyone unfamiliar with the sustained research which is an inherent part of the story of Rubber.

In a single airplane there are hundreds of rubber parts, including hose for fuel, oil lines and hydraulic controls; packings, and vibration dampeners.

Tanks need rubber at many points—rubber that will withstand heat, cold, oil, abrasion.



Submarines require acid-resisting rubber for battery compartments; other kinds of rubber in gaskets, mountings, and for scores of special applications.



Thousands of pounds of rubber go into every warship at hundreds of places from propeller shaft to gun decks and fire control tower.

Trucks and gun carriages require rubber for hydraulic brake parts, for shock absorption, and for other vital uses.

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